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EMPIRE COTTON GROWING CORPORATION

REPORTS RECEIVED FROM EXPERIMENT STATIONS

1930-1931

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1932

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PREFACE

By J. C. WILLIS, M.A., Sc.D., F.R.S.

On the instructions of the Executive Committee, following a recommendation made by the Research Station Committee, an alteration has been introduced this year into the method of presentation of these annual reports, and it is one which we cannot but think will meet with the approval of those who read them, whose numbers it is also hoped may be increased by this means. While it is the duty of all those who are engaged in the actual prosecution of such work as is here described to read and consider the reports in detail, it is felt that they have been somewhat too bulky for those who are engaged in other occupations; and naturally these latter people have also to be considered if the Corporation is to succeed in interesting them in the work that is going on. With this object in view, the Committee has therefore decided that each individual station should only bring out a full report once in three years; there will thus be only four full reports as a rule in each volume, while the other stations will produce each a brief summary.

In the present volume there are full reports from Iraq (included for the first time by courtesy of the Iraq Government), the Anglo-Egyptian Sudan, Uganda (included by courtesy of the Uganda Government), and Southern Rhodesia, and it is hoped that general readers may be able not only to find the time that is necessary to read the summaries for South Africa and other places, but also these detailed reports, for no summary can do proper justice to the great amount of useful work that is being carried out by the officers of the Corporation in different parts of the Empire—work that is at the present time perhaps even more to be desired than usual, for there are distinct indications that when the present period of depression is at last over, the world situation may show changes in the existing position with regard to the production of cotton. If, as one hopes, it be then a question of expansion in new directions, those countries will have the greatest advantage that have most carefully prepared themselves for the future during the present "resting period." This period gives the further advantage to workers that they are less liable to interruption by the continual day to day queries that are inseparable from a season of expansion, so that they can get along better with their more strictly scientific work.

Though the setting out of the reports is thus altered, we shall continue to deal with their general subject matter in the same order as heretofore, for the sake of uniformity and of comparison; and for the same reason the reports themselves appear in the same order as before. We shall therefore begin, as previously, by dealing with the work upon plant breeding, which at present is probably the most important of the many lines of work that are in progress. It must not be forgotten that in much of the Empire cotton is practically a new crop, so that there are no traditional methods of cultivation and treatment to go upon, nor are there always locally (and this is of still greater importance) successful varieties with which we may work in breeding, knowing that they suit the locality, and have only to have added to them the needful qualities of yield, staple, and the like to make them all that is required to start the industry. In many countries, everything about cotton has to be found out from the very beginning, and this involves a very great amount of careful and thorough scientific work, in addition to equally careful and thorough work by the agricultural officers concerned with the best methods of cultivation and preparation.

The breeding work described in the reports is, as last year, to a very great extent concerned with the success (or in rarer instances the non-success) of U.4 and its derivatives. In S. Africa, for example, "The low veld area is now all under U.4." "Since the introduction of this strain severe jassid attack has become a thing of the past. Last year there was none"; "remarkable power of recovery . . . quite capable of producing good crops after the bollworm attack has passed off, provided soil moisture is sufficient, and the attack not too late in the season." Some of the new strains produced from U.4 appear to be significantly better, but it is too soon yet to make any definite statement. Some of the new Swaziland strains also appear to be good.

In S. Rhodesia "none of the varieties came up to the U.4 selections, /64 was issued to farmers, and did well; unfortunately its ginning percentage is low (for U.4). It appears to be the best of the Gatooma stocks, and is being largely selected from." Selection from U.4 was also continued in Northern Rhodesia and in Nyasaland.

In Uganda "the most outstanding result . . . was the failure of U.4 to repeat its supremacy . . . of last season." In the Anglo-Egyptian Sudan "selections gave promising results"; "the outstanding success of U.4 in Mongalla and the Nuba Mountains, a success due in no small measure to the high ginning outturn."

Finally, in Nigeria, where jassid has been troublesome, "in this one season U.4 does not seem to show any superiority."

Outside Africa the variety has not been tried.

As last year, the general success of U.4 has tended to overshadow other work, and that the more the nearer that one comes to its focus in S. Africa. A great deal of useful work is, however, in reality being done upon breeding other types, especially in regions further removed from S. Africa. Even in the latter country itself the value of the jassid-resisting qualities of the Cambodia cotton (cf. last year's report, pp. 5-6) is fully recognised, and experiments with it have been continued there and in other places. But whilst it certainly carries this one very desirable quality, its other qualities are not so good, and care is therefore needed when using it in breeding, to be sure of the non-introduction of these latter qualities into new strains.

In Uganda some of the S.G. strains proved as good as U.4, but "the outstanding feature of the season was the failure of S.G.23.8 owing to its great susceptibility to jassids." S.G.29 reached the seventh stage in multiplication, and was widely distributed to farmers.

In the Sudan a good deal of work was done with other strains, and some selections from S.G.85, from Delrect, from Columbia, and from Meade gave promising results. The last mentioned, for example (A.6/30) showed a lint of about $1\frac{3}{16}$ins. and a relatively high ginning outturn (many of the Sudan selections, though good in other ways, were disappointing in this respect). X.A.02629, a selection from Columbia, seems to be a good cotton, and so is X.A.1129, though a bit rough and harsh.

In Nigeria, jassid having come into prominence as a pest, strain D, which proved to be very susceptible, was dropped, and attempts were made to produce, or find, a jassid-resistant strain.

In Iraq no variety has yet proved superior to Mesowhite, whose chief disadvantage is its low ginning outturn. R.124, which has a higher ginning percentage, and a similar quality of lint, is doing well at Rustam, and Acala gives a higher yield, but poorer quality, so that it is still doubtful whether it would really be more profitable than Mesowhite. The seed issued to farmers since 1929 has been practically confined to strains of the last named.

With reference to breeding in other than American cottons, attempts have been made in the Sudan to produce types resistant to leaf curl, and indications were obtained that breeding may render this possible, several highly resistant forms having been found, including two Sakel × Sea Island hybrids. Shambur Sakel IV, which is resistant and does not shed badly, is being propagated upon a large scale. In Fiji, the Sea Island×New Guinea back-crosses continue to show promise, and the hybrid has doubled the yield obtained from Sea Island.

Important work was put in hand by Dr. Harland at the new station in St. Vincent. Two superfine strains of V.135 have been selected for testing and multiplication, and seed will be available for the whole island in 1933. The Trinidad Red Kidney×Sea Island cross has given very promising results, and so have some Moco strains and others.

Passing on to methods of cultivation and of harvesting, rotation of crops, whose importance was explained in last year's report, comes first. Considerable attention has again been devoted to it, and a lot of work is described in these reports. It must always be kept in mind that the rotation crops must themselves be economic propositions, and therefore that their methods of cultivation and of treatment, their susceptibility to disease (with the breeding of resistant varieties when necessary), their marketing, etc., must be investigated with as much care and thoroughness as is given to the cotton itself. Thus with soy bean, work is S. Africa has shown that only strains that are resistant to shattering are worth serious consideration, while at the same time close drilling has proved to give a much heavier crop, so that this method of treatment is evidently desirable. With the sunflower, on the other hand, wider spacing (at any rate to 30″) has given better results. In S. Africa a great range of beans has been tried for the leguminous crop in the rotation, and the only ones found likely to be an economic success are soy, tepary, and Lima beans.

In Swaziland climatic conditions, and especially drought, were against the rotation crops, so that the only one reasonably successful was the groundnut. Here, evidently, much more work is yet necessary to discover a good and economic rotation. Maize and pigeon pea continued to do well in Nyasaland, while bulrush millet was fairly successful in Nigeria. In Iraq wheat and barley, with two bare fallows, are the usual rotations, the rotation being winter cereal, bare fallow, cotton or other summer crop, bare fallow, winter cereal again. The first fallow lasts about a year, the second about nine months. Lately linseed (winter) has become a popular crop in the rotation. In summer the water supply limits the possibilities ; the question as to whether a green leguminous crop cannot replace a fallow has not yet been satisfactorily solved, but berseem seems promising.

The low prices obtainable for cotton have everywhere stimulated attempts at economical production, and in consequence the question of ratooning is once more coming into prominence in Southern Rhodesia and elsewhere.

Last year we mentioned fallowing, and pointed out that this seemed likely to be a matter for each country to settle in accordance with local conditions. This year's experiments continue to bear this out.

Time of sowing experiments were fewer, but continued in general to indicate early planting as desirable, whilst the experiments on spacing again indicated a closer spacing as better than the systems in general use, though the actual best distance apart in the row varied in different places from 6″ to 15″. The remarks made upon this subject last year may be referred to.

Other matters that were made the subject of investigation, and that bear upon the question of greater efficiency in cultivation, include fertilizers in S. Africa, Swaziland, S. Rhodesia and Iraq, boll-shedding in N. Rhodesia, topping in S. Africa, height of thinning in Swaziland, and soil conditions in Nyasaland.

Intercropping, which, as we have elsewhere pointed out, gives some of the advantages of rotation of crops, was made a subject of investigation in Nyasaland, while in Iraq a beginning has been made with the very important subject of the deterioration of irrigated land by the accumulation of salts.

The climate experienced at the various stations shows the usual range of variation from the average—a severe drought in most of S. Africa, with disastrous results in many places ; late arrival of the rains in Swaziland ; protracted drought in February and March in S. Rhodesia ; a violent storm with over 5″ of rain just after planting in N. Rhodesia, with another just after replanting ; excessive rain at first in Nyasaland and none for six months afterwards ; abnormally high rainfall in the Sudan ; dry planting weather in Nigeria ; a hurricane and floods in Fiji ; the worst climatic conditions encountered since the station was opened in Queensland ; and so on. As usual, only about two or three of the stations had really good climatic conditions, but this is normal enough, simply resulting in delay and inconvenience with the work going on upon the rest.

Some interesting more purely physiological work has been done in S. Africa, S. Rhodesia, Uganda, Queensland, the West Indies, and elsewhere, but it is early yet to draw deductions therefrom.

To turn finally to the very numerous pests and diseases by which cotton is troubled, and which often (as was the case with the jassid in S. Africa) spell the difference between success and failure, the first and most generally important are the various species of bollworm, of which the American (*Chloridea*) appears to be in general the worst. (It is a matter for congratulation to ourselves, and a testimony to the efficiency of inspection in the U.S.—that the Empire, and indeed the whole outside world, has not been troubled by the boll weevil, which is a much worse pest.)

Comparatively little has yet been done in breeding strains resistant to the bollworms, but attention should be called to the fact that U.4, as mentioned above, has a "remarkable power of recovery after . . . bollworm," and "appears to be quite capable of producing good crops after the bollworm attack has passed off, provided soil moisture is sufficient and the attack is not too late in the season."

Experiments in S. Africa with exposure of the pupæ by means of farm implements were sufficiently successful to warrant their continuance, but light-traps proved of little use. Work upon parasitic enemies is in progress, and will be fully described at a later date. Bollworm attacks, sometimes of one species, sometimes of another, are recorded for a good many of the stations, but no general and economic method of attack upon the pest has yet been found. Dusting for example, while effective in Iraq, is hardly economic. Important experiments with stripping of cotton plants (to represent the effects of an attack of bollworm) were set in hand in S. Africa, and results will be published in a future volume. The results are reported this year of somewhat similar experiments in the Southern Sudan also.

Stainer (*Dysdercus*) is another formidable insect enemy, and a good deal of work has been done bearing upon protection against it. The insect was much in evidence in S. Africa and attempts were made there and in N. Rhodesia to obtain statistics of the attack and of the damage done. It was found in S. Africa that stainers could be destroyed wholesale on small seed heaps by spraying with an emulsion of common soap, and that by repeating this at intervals, the stainer population could be much reduced.

In Swaziland little damage was done owing to the quick finish of the season. In S. Rhodesia experience with trapping appears to have been more satisfactory, but in general this method has proved too costly. In N. Rhodesia it was noticed that a higher and cleaner yield was obtained from plants growing on the lighter type of two soils that occur together, and it is possible that this discovery may prove of use in combating the attacks of this insect.

The remarks made about jassid above and in last year's report are equally applicable this year, and no further detail need be entered into.

Other insect pests that are mentioned in the various reports have not usually as yet shown signs of becoming major pests. The most important are the locust in Iraq, and *Heliothis* in Queensland.

To turn to diseases as distinguished from pests, the two most important are leafcurl and blackarm; indeed they are practically

limiting factors in the Sudan. Various papers have been published in the Empire Cotton Growing Review dealing with them, and the breeding of resistant varieties, which is perhaps the most promising method of attack, has been described above. In Uganda a strain B.31 was found to show complete resistance to angular leaf spot, and others were very fair.

QUEENSLAND

REPORT ON THE WORK OF THE CALLIDE COTTON RESEARCH STATION, BILOELA, FOR THE YEAR ENDING JUNE 30, 1931.

Summary of Results.

BY

W. G. WELLS.

The climatic conditions during the season just closed were the worst that have been experienced since the Research Station was established. No planting rains fell until mid-January, and then only patchy stands were obtained until the end of the month, when good rains completed the germination.

The stands in all experiments were in consequence very irregular in height, the plants of the first germination being about four inches high when the rest of the seed germinated. The seasonal conditions following were very favourable, however, and but for a late corn-ear worm attack, sufficient yields would have been obtained to have made the results of interest. As it was, all experiments were so badly attacked that no picking was made.

The progeny block, which was planted at a normal time by irrigating from the domestic pump, produced a heavy crop, the fibre of which was of good strength, but somewhat shorter than the average usually obtained.

An increase plot of strain DB. 13-5 which was planted in mid-January on land under crop for the second year only, produced much better yields than did the older cultivations, again showing the greater range in the time of planting that is possible with new cultivations.

In spite of such adverse conditions, certain features were observed which appeared worth recording as being of value for cotton-growing under various conditions. Briefly these were as follows :—

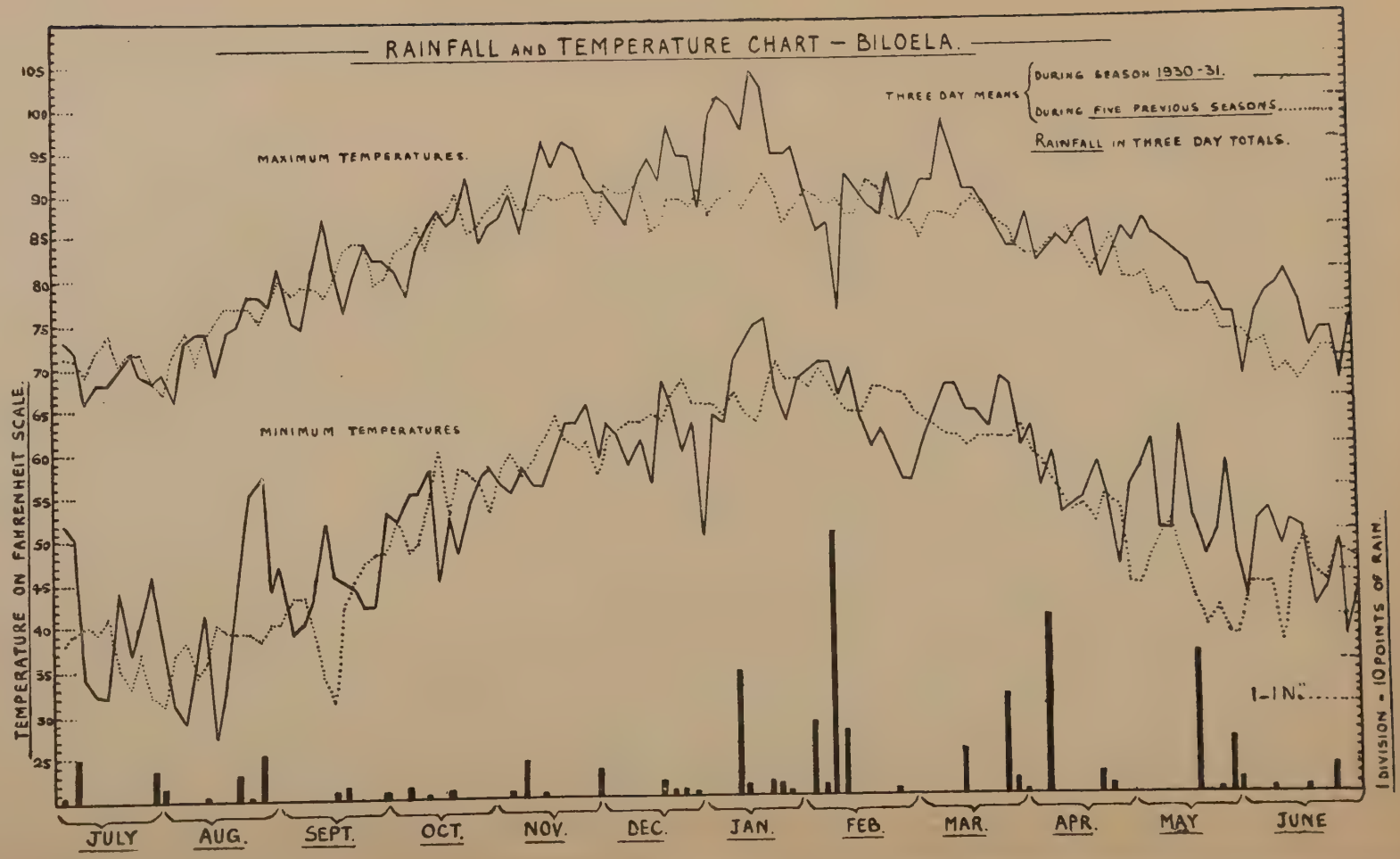
1. Early planted cotton offers the best chance of obtaining profitable yields, provided that further useful rains fall soon enough to assure that the plants will function as early cotton.
2. Late plantings are decidedly hazardous, but may produce profitable crops even on rich soils, if the rainfall is just sufficient to supply the requirements of the plants, so that succulent growth does not develop, and provided a long frost-free harvesting period occurs.

3. Late plantings should be placed in old cultivations if on clays or clay loams, but preferably in new cultivations if on rich alluvial flats.
4. Moisture determinations in plots fallowed for the whole season, failed to indicate that ploughing under cowpeas increased the moisture-holding capacity of the soils during the second season after the plough under. No significant differences were obtained between the same two plots in the previous season when one was in cotton following cotton and the other in cotton following the ploughing under of the cowpeas.
5. Investigations into the power of nitrification within the first foot of soil in new cultivations as compared with the first foot in the older cultivations on fairly comparable alluvial clay loams, indicated that, starting from approximately nil, in 56 days the parts per million of nitrogen as NO_3 rose only to 7·5 in the former ; whereas, in the latter, the increase was from 20·8 to 44·9 parts per million in the same period. In an adjacent plot which had been broken up 18 months previously from the original grass land and had grown one crop of cotton, the readings were 13·5 and 38·8 parts per million respectively. It is believed these results help to explain the tendency to make rank growth shown by late plantings, or by late developing early plantings, on the rich alluvial loams and clay loams, especially in crops experiencing heavy mid-seasonal rainfall.
6. Ploughing under wheaten straw produced some partial initial reduction in nitrogen as determined by soil analysis. Some slight hardening of plant growth may possibly have been obtained early, but not visibly so later in the season.
7. Experiments on similar soils in other districts, where heavier rainfall was experienced, indicated that varieties of cotton with an open plant structure and maturing the crop quickly may offer possibilities of solving the problem of controlling rank growth of late planted crops.
8. *Heliothis obsoleta* Fab. is undoubtedly one of the most serious limiting factors to crop production in many parts of this State. This is especially true in late plantings, and also in early plantings which are delayed in their development.

General Remarks on the 1930-31 Cotton Crop in Queensland.

Such adverse conditions as existed at the Research Station were confined especially to the Northern half of the Callide Valley, the Dawson Valley, and districts inland from Rockhampton. The more coastal areas near and South of Rockhampton, and even in the Southern portion of the Callide Valley adjacent to the mountains, received early local showers and obtained good crops. Two growers increasing bulk selected strains of Durango developed on the Research Station, are worthy of mention, in that one averaged 1,499 lbs. of seed cotton per acre on a 66 acre block, while the other averaged 2,100 lbs. on a 38 acre block. During the coming season 4,000 acres of this strain will be distributed in two compact blocks in these growers' section of the district.

More favourable climatic conditions existed in the Southern districts of the State, and profitable returns were generally obtained. Many growers produced yields of 1,200 to 1,500 lbs. of seed cotton per acre, and 1,800 lbs. were not uncommon. Some outstanding yields of 2,000 and even up to 2,500 lbs. per acre were also obtained. Such results have greatly stimulated interest in cotton-growing, and as the prices for other agricultural crops are very low, many new growers are applying for seed, while the old growers are increasing their acreages. It is anticipated that seed sufficient to plant at least 65,000 acres will be issued for the coming season.


RAINFALL AND TEMPERATURE CHART – BILOELA.
THREE DAY MEANS
DURING SEASON 1930-31.
DURING FIVE PREVIOUS SEASONS.
RAINFALL IN THREE DAY TOTALS.
MAXIMUM TEMPERATURES.
MINIMUM TEMPERATURES
TEMPERATURE ON FAHRENHEIT SCALE.
105
100
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1-1N°
1 DIVISION = 10 POINTS OF RAIN.
JULY
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NOV.
DEC.
JAN.
FEB.
MAR.
APR.
MAY
JUNE

SOUTH AFRICA

REPORT OF THE CORPORATION'S WORK AT THE STATIONS AT BARBERTON, TRANSVAAL, AND IN SWAZILAND, FOR THE SEASON 1930-31.

Summary of Results.

Introductory Note by Mr. S. Milligan.

The condensation of the Annual Reports of Cotton Stations under the control of the Corporation in the Union of South Africa and Swaziland has presented some difficulty to the writers. This has been overcome to some extent by the omission of the Magut Station Report altogether and in a large measure by the relegation of discussion of results to future publications. A chapter in Mr. Parsons' Report on the observations of reared bollworm parasites under field conditions has had to be left out. It was found quite impossible to summarize these without detailed explanations.

The character of the season 1930–31 has been described in the Barberton Report. Rains were late in arriving but good growing conditions followed and much leeway in growth was made up during the first two months. A severe drought then set in throughout the greater part of South Africa with disastrous results in many places. Total crop failures were common. Cotton again showed up well as a drought resister in comparison with other crops. In spite of everything some quite good yields were recorded. For example, a neighbouring farmer at Barberton had the high average of 1,050 lbs. of seed cotton per acre over his whole area with one of the U.4 re-selections.

The low veld cotton area is now all under the U.4 variety. Since the introduction of this strain severe jassid attack has become a thing of the past. Last year there was none. Attention has been called in previous Reports to the remarkable power of recovery of this cotton after drought and bollworm. Speaking quite generally from field experience, the Bulk (unselected) U.4 cotton at present grown in the district appears to be quite capable of producing good crops after the bollworm attack has passed off, provided soil moisture is sufficient and the attack is not too late in the season. The importance of retaining this quality is obvious and the "stripping" experiments (Barberton Station Report) designed to compare the behaviour of two extreme types during and after bollworm attack are therefore of first-rate importance.

The past season, owing to the invasion of cotton stainer at the Barberton Station, a fortunately unusual occurrence, has not done

much towards deciding the re-selection problem. The most reliable results come from the two Stations in Swaziland, where the season proved a good one and the yields in the case of one were very high. There appears, however, to be wisdom in moving slowly in this direction, as it is just as easy, by plant breeding, to fix weak as strong characters, and the strains require to be subjected to all sorts of difficult conditions before they can be finally passed for general use.

The study of conditions (mostly local in character) affecting the growth of the cotton plant, especially in its early stages, is of importance in countries like South Africa to which the crop is new and where little is known about its cultivation. Much assistance is to be had in the direction of saving time and checking of plot yields, by actual measurements in the field of plant development such as are now being carried out at Barberton. Results of the past year's work confirm that of previous years as to the deleterious effect of a previous fallow and the advantages of winter ploughing on cropped land. An increased yield from the use of phosphates was revealed by a combination of plot weighments and plant growth measurement. Years of trials with " district " plots had previously failed to detect any significant results.

As mentioned above, the Report on the work on insects has had to be seriously curtailed. The bollworms and stainers remain the chief pests in South Africa. Considerable progress has been made in the study of the vulnerability of red bollworm pupae in the off season, and experience gained in the rearing and liberating of one of the egg parasites originally discovered by Mr. Parsons in a wild state in Northern Zululand. From the Report it will be seen that it has now become possible to devote some attention to cotton stainers which are probably the most widely distributed of all cotton pests throughout Africa, and which form a limiting factor to the growing of the crop over large areas of the Continent.

The additions to the staff at Barberton have enabled the important question of crops suitable for rotation with cotton to receive more adequate attention. The main crops grown are maize, sunflower, groundnuts and a range of beans which have now been reduced to three in number, viz., soya, tepary and lima. Correct spacing appears to be of very great importance in growing beans, some varieties being much more capable of utilizing space than others. Liming produced a marked effect on soya beans both in growth and in the formation of bacterial root nodules.

Mr. Parnell proceeded on six months' furlough in May. He had been in charge of the Barberton Station for seven years without leave of any kind.

THE COTTON-BREEDING STATION, BARBERTON. SEASON 1930-31.

Report on the Plant Breeding Work.

BY

D. MACDONALD.

Season and Climatic Conditions.

The total rainfall recorded for the year July to June inclusive was 20·87 inches, being about 8 inches below the average for the previous fifteen years.

The season started very late, the first effective rain falling on December 4th. Previous to this date, apart from winter ploughing, little could be done in working down the land into a good seed bed. Most of the cotton crop was planted during the ensuing ten days, and, following the rains of December 23rd and 24th, good stands were obtained. Moisture and temperature conditions during the next two months were favourable to rapid growth of the crop, apart from damage through wash caused by a fall of 4·77 inches of rain on January 31st and February 1st. Fortunately this fall of 4·77 inches established a good reserve of moisture and the dry spell from February 20th to March 30th was not felt very seriously by the crop.

Growth on the whole was rather small, but flowering and setting of fruit were extraordinarily good considering the lateness of planting and the limited rainfall.

Rainfall conditions throughout the district were somewhat similar to those experienced on the Cotton Breeding Station, but cotton in the lighter soils in the valley suffered rather more from drought during March.

A further rain in the beginning of April, useful on the heavier soils for finishing off the crop, was too late to be of any great value in the lighter granite soils.

The acreage under cotton in the district was rather less than that of the previous year, as the later advent of rain prevented ploughing and general preparation of the land that would normally have been planted with cotton. Although the crop on the Station was planted a month to six weeks later than what is considered the optimum planting period, the favourable conditions after planting would have meant a very good crop despite bollworm activity during the latter part of January and early February. Unfortunately boll rot caused by an

infestation of stainer (*Dysdercus*) in early March and continuing throughout the remainder of the season did so much damage that only a small proportion of the crop opened undamaged. The infestation was local and mainly confined to part of the western side of the valley.

Selections.

The work of selecting within the various types of U.4 continued along the usual lines of previous seasons. A total of 378 single-plant selections were planted over an area of approximately 15 acres. These, with the exception of 18 Cambodia selections, were all from U.4. They were all planted during the second week in December, good stands being obtained, and under the favourable conditions after December 23rd growth was very rapid.

No big differences in susceptibility to jassid attack were observed either within or between families. This is due partly to the fact that jassid attack was comparatively light during the season, and partly to the fact that the very severe attack of jassid in the previous season ensured that any selections made would have a very high degree of resistance.

Single-plant selections were made from a number of different families, but stainer attack damaged the crop so badly that very little viable seed could be obtained from any but the very earliest strains. Fortunately a reserve of seed from the last season's selections is available for re-planting.

Variety Tests.

On the results obtained in the previous season seventeen of the special bulks taken were tested out along with U.4/4, U.4/2 and U.4 Bulk. Three trials were laid out, each containing twelve strains and Bulk, the grouping of the strains being such that each of the nineteen strains appeared in two tests, while U.4 Bulk was included in all three.

The tests were laid out in randomized blocks with six repetitions for each strain per trial. This gave twelve repetitions of each strain tested, apart from Bulk, which, appearing in all three tests, was replicated 18 times.

Boll rot caused by stainer attack was so severe that only a small proportion of the crop opened properly. It was accordingly impossible to take seed cotton yields per plot and try converting the figures to lint per plot in order to compare the performance of the strain in the trials by the method adopted in previous seasons.

As it was felt that some means of arriving at the respective merits of the different strains, other than by observation during the season, should be obtained, it was decided to get this by boll-stripping.

The following method was adopted :—Groups of plants in line 4 to 6 in number were taken in all plots, each group being chosen as a representative sample of the whole plot. In this way 30 or more plants were taken per plot and stripped of all bolls. In stripping the plants all bolls which were likely to mature and open under normal conditions were taken.

Samples were taken of undamaged well-opened bolls from all over the plants, and using the boll weight and ginning percentage from the above samples the figures obtained for the number of bolls per plant were converted into grms. lint per plot. From the lint figure obtained the significance of yield difference was worked out by Fisher's Analysis of Variance.

The results showed up two strains, viz., 921 and 9312, as being very significantly better than Bulk in both tests in which they appeared, while eight other strains were significantly better than Bulk in one out of the two tests which included them.

A further variety test, including ten of what were regarded as secondary lots, together with U.4/4, U.4/2 and Bulk was carried out. The same method of analysing the results as in the previous trials was adopted, and showed five strains to be very significantly better than Bulk.

Apart from the fact that the results obtained by the above method tended to confirm the opinion formed by observation during the season, it is not intended to regard the results obtained by this method as in any way conclusive.

The whole of the series of trials will be re-planted next season.

SPACING.

An experiment was carried out to test the effect of various spacings on two different varieties. The varieties used were U.4/4/2, a small very early-fruiting type, and H.77, a stronger, later, more vegetative type. The spacings adopted were 6, 12, 18 and 24 inches in the row with a standard inter-row spacing of 3 feet 6 inches. Five repetitions of each spacing using 8-row plots were randomized in blocks.

Daily flower counts were made on two lines of each plot in four blocks. The closer spacings, as was to be expected, produced a greater number of flowers in the early part of the season, but fell off much more quickly during the dry spell in March.

As in the case of other experiments, stainer attack interfered so much with the opening of the crop that no significant differences were obtained between spacings in either variety.

Topping Experiment.

An experiment was carried out to attempt to find out the effect of topping on different strains at different stages of growth, from the point of view of stimulating early setting and ripening of the crop, a vital necessity in a season which begins late and closes down early.

The strains used were 955, a small early-fruiting type, and 920, a later, stronger growing, more vegetative type. Both strains were planted on December 10th and the toppings, which consisted in cutting off the main stem two nodes below the apical bud, were done on the following dates :—

1st Topping	...	...	February 5th.
2nd Topping	...	...	February 27th.
3rd Topping	...	...	March 23rd.

The treatments were randomized in blocks using untopped plots as control, there being four repetitions of each treatment. The treatments represented early, middle and late season topping.

On analysis of yield figures no significant difference was obtained between treatments. Reasons for this will be gone into when a full report is written. The experiment will be repeated during the coming season.

Stripping Experiment.

On the same two strains, namely, 955 and 920, an experiment was designed to find out the reaction to and recovery from bollworm attacks, shown by different strains at different stages of growth throughout the season. The plots were planted on December 10th and an effect similar to that of bollworm attack was produced artificially by hand stripping of bolls, flowers and squares. The treatments were as follows :—

1. Hand stripping of flowers daily from February 12th, 1931, throughout the season.
2. Stripping of all bolls, flowers and squares on February 27th, 1931, the plots being allowed to continue untouched thereafter.
3. Stripping of all bolls, flowers and squares on March 23rd, 1931, the plots being allowed to continue untouched thereafter.

The experiment will be repeated over a number of seasons and the results obtained discussed in detail when a full report from this Station is written.

REPORT ON THE PLANT PHYSIOLOGICAL WORK.

BY

O. V. S. HEATH.

PLANT DEVELOPMENT AND CLIMATIC CONDITIONS.

In continuation of the work of previous seasons, plant development data were collected for comparison with climatic conditions as measured by meteorological data. Two-daily growth measurements were carried out on 45 plants, and daily flower counts and weekly pickings on 135 plants, in a multiplication plot of 920 S.B. (a selection out of U.4/2). This was planted on December 10th and may be taken as more or less representative of the main planting for the season in question. In addition, two-daily growth measurements were made of 45 plants in the same plot, which were stripped of all squares and monopodial shoots as they appeared. The object of this stripping was to relieve the plant of the drain caused by developing flowers and bolls, and to ensure that most of its resources should be put into growth of the main stem. The height measurements would thus provide a more accurate measure of the effect of climatic conditions on growth. These stripped plants have provided interesting results which will be dealt with in the next full report from this Station.

The growth and flowering curves (unsmoothed) of the unstripped plants are shown in Fig. 1, as are also the mean soil temperature at 6 inches depth, soil moisture at 12 inches depth, mean air temperature, rainfall and wind. The meteorological data were obtained as described in last year's Report. The main features of the season were the very late start followed by favourable conditions for growth (good soil moisture and fairly high temperatures) and the drought in March. This drought probably contributed to the rapid falling-off in the latter part of the flowering by inhibiting flower-bud formation. The performance per plant is summarized below. The low yield of clean seed cotton was largely due to the serious infestation of stainer, and the figure for " Total number of bolls opened per plant " includes a large proportion of stained bolls.

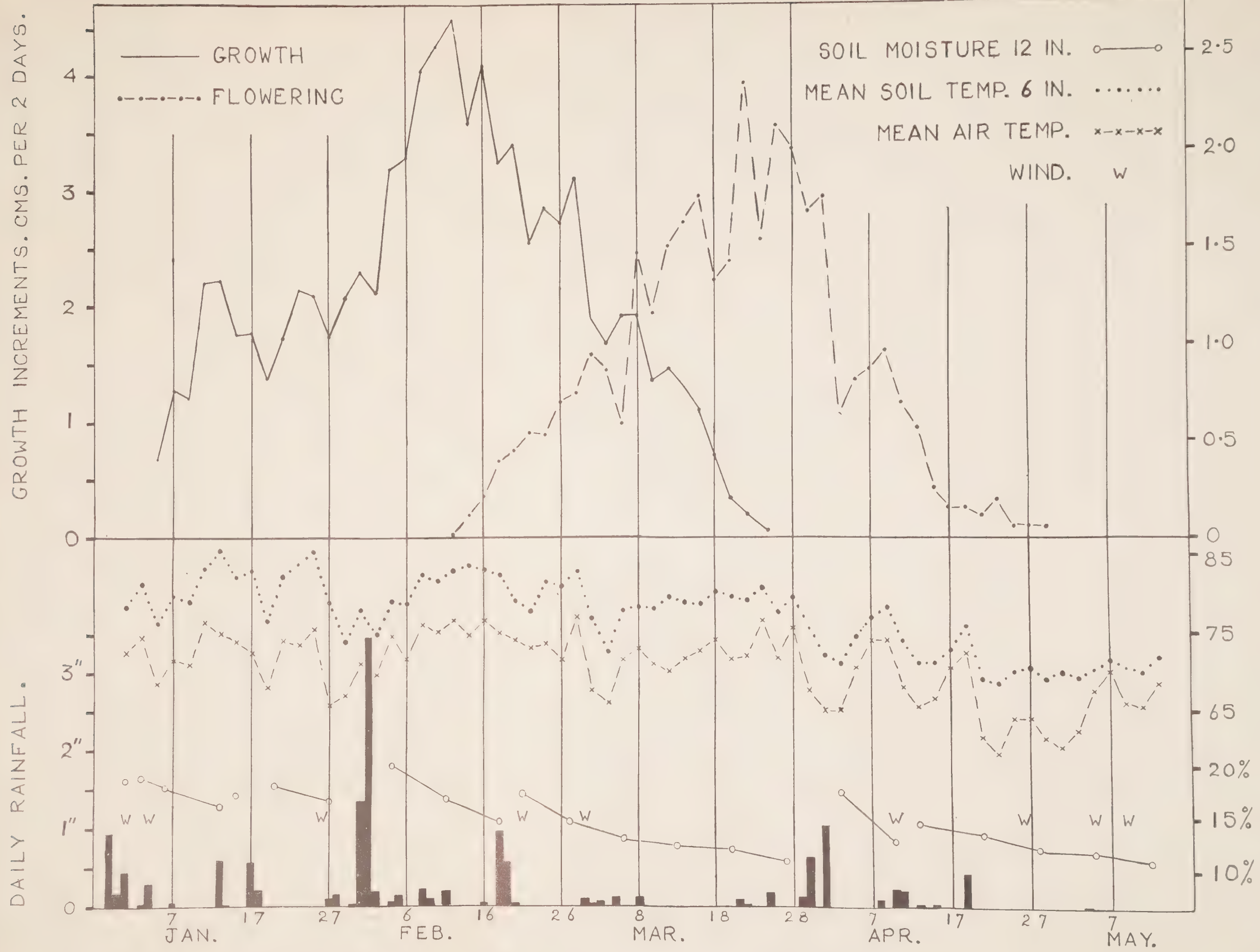
Total number flowers per plant.	*Total number bolls opened per plant.*	*Bolls per cent. of flowers.*	*Wt. of clean seed cotton per plant in grms.*
67·1	24·4	36·4	54·4

That the short period fluctuations in growth rate are correlated with temperature to a considerable extent, as in previous seasons, can be seen from the curves in Fig. 1. In order to find the amount of this correlation, regression curves have been fitted expressing the relations between growth and time (for both normal and stripped plants), mean air temperature and time, and mean soil temperature and time. Making use of these regression curves, high and very significant values have been obtained for the correlation coefficients between growth and temperature. These results will be discussed in detail in the next full Report from this Station. This work will be continued in the coming season.

Effects of Soil Treatment.

The present season's experiment to investigate the effects of previous cropping and time of ploughing upon the growth and development of the cotton crop was unfortunately of a somewhat makeshift nature. Owing to a definite experiment not having been laid down in crop and fallow during 1929-30, it was necessary to make use of a piece of land that had been half fallowed and half under cotton during that season. This field was new land and was somewhat irregular. It was winter and spring ploughed in strips at right angles to the cotton and fallow strips. In this way four soil treatments were obtained, namely, winter ploughing after cotton, winter ploughing after fallow, spring ploughing after cotton and spring ploughing after fallow. The winter ploughing was rough and lumpy (on both the fallow and cotton land) whereas the spring ploughing gave a smooth fine tilth. The spring ploughing could not be done before December 26th, 1930, as until then the rainfall had been insufficient to give really smooth ploughing. The experiment was planted all through with U.4/2 cotton, but owing to the extremely late planting date (January 6th) necessitated by the late ploughing, the crop made very poor growth. The effect of fallowing and of time of ploughing upon the growth of the cotton was, however, similar to that shown by the previous experiment. The cotton grown on land which had been cropped and winter ploughed was markedly earlier than that on the other three treatments. The soil moisture and soil temperature data showed considerable irregularity within treatments. The soil moisture figures showed on the average the same effect as in the previous season, *i.e.*, the soil that had been cropped and winter ploughed dried out most quickly, while that which had been fallowed and spring ploughed dried out least quickly. On the other hand, the soil temperatures showed differences between the treatment averages in the direction opposite to that found in the previous season, *i.e.*, the maximum temperatures were highest on the fallowed spring

FIG. 1. PLANT DEVELOPMENT AND CLIMATIC CONDITIONS, 1930-31.



ploughed land, and lowest on the land that had been cropped and winter ploughed.

A method of measuring " Soil Compactness " was tried out towards the end of the season in connection with the above experiment. It gave promise of being useful and will be employed during the coming season.

In continuation of this work a randomized block experiment was laid down during the present season with plots of mealies, soy beans and fallow. Each plot is divided into two sub-plots which are being winter and spring ploughed respectively. The experiment will be planted all through with cotton in the coming season.

FERTILIZER EXPERIMENTS.

During the present season a beginning was made in the investigation of the effects of various fertilizers upon cotton. An experiment was carried out, in collaboration with Mr. MacDonald, in order to find the effects upon the growth and yield of cotton of nitrogen, potash and phosphorus fertilizers applied both singly and in combination. The fertilizers applied were sodium nitrate (N) at 200 lbs. per acre, potassium sulphate (K) at 150 lbs. per acre, and superphosphate (P) at 200 lbs. per acre. The eight different treatments, each of which was repeated five times in a randomized block layout, were as follows : K ; P ; N ; KP ; KN ; PN ; KPN and nil. The only fertilizer that had any significant effect either on growth or yield was the superphosphate. This is clearly shown in Table I in which the results have been grouped, in means of four treatments each, as " With P," " Without P," " With K," " Without K," etc. The beneficial effect due to the presence of superphosphate is highly significant statistically both in the final yield and in the growth of the main stem. The differences due to the presence or absence of potash, or of nitrogen, are all quite insignificant. None of the interactions between different fertilizers had a significant effect on growth or yield.

TABLE I.

FERTILIZER EXPERIMENT.

	Means of four treatments.						
	With P	*Without P*	*With K*	*Without K*	*With N*	*Without N*	*Standard error of difference of 2 means.*
Growth rate of main stem in cms. per week. 16–23.2.31 (the period of peak growth) ...	12·7	10·7	11·7	11·7	11·7	11·7	0·35
Final height of main stem in cms.	85·0	76·5	81·0	80·5	80·9	80·6	1·65
Yield in lbs. per acre of seed cotton	522	418	484	456	469	471	34·1

In view of these results another fertilizer experiment is being laid down for the coming season in which the superphosphate will be applied at two different rates per acre. It is intended to retain this as a permanent experiment.

Lime.—Large-scale observation plots, that had received respectively one ton per acre of lime and no lime showed no obvious differences in the cotton crop. A small experiment with lime applied at several different rates up to 10 tons per acre will be laid down in the coming season.

Summary of Work on Cotton Insect Pests Control.

BY

F. S. PARSONS.

The investigations of means to control the red bollworm, the American bollworm and species of cotton stainers, summarized in part in the present Report, extend over a period of two years, commencing in October, 1929.

The work reported on has been carried out to a considerable extent by Mr. G. C. Ullyett and the author in collaboration, except during a period of six-and-a-half months, latterly, when Mr. Ullyett has been on leave.

Red Bollworm.

Exposure and destruction of pupae by means of farm implements.—Investigations are being made on the use of farm implements when employed for the purpose of destroying the pupal stage by direct and indirect means. Great importance is attached to possibilities in this direction. A brief account of some preliminary experiments is given in the following paragraphs.

Quantitative data on the lateral distribution of the pupae of this bollworm in cotton fields showed that 78·5% of them rested within the space between rows of cotton plants through which cultivating implements pass. The remaining 21·5% rested near or in the plant row.

Quantitative data on the vertical distribution of the pupae in soils in the field showed that 62·5% rested between the soil surface and a depth of 3 inches, 32·8% at depths from 3 to 4 inches, and 4·7% at depths from 4 to 6 inches. Based on these proportions, about 50% of the pupae in the cotton lands were located in the upper 3 inches of the soil within the area covered by an inter-row cultivating implement and except under extreme conditions of soil packing, susceptible to being moved by it, without injury to roots.

As the cultivation of cotton ceases ordinarily about the time that larvae from the first generation on plant cotton are pupating and before larvae derived from late spring emergences of moths have completed the larval stage, it would appear, in view of the above data, that additional operations with inter-row cultivating implements might be advantageous as a means of reducing subsequent, and in particular March–April, bollworm, on the assumption that the implements would pull out pupae to the soil surface.

Preliminary trials in quadruplicate were designed in order to test the utility of three types of cultivator as commonly used, when employed for the purposes of exposing pupae. In the trials the implements were drawn through areas prepared with particular care as to the randomization of the sites and depths of the points at which pupae were inserted, and in general, careful simulation of field conditions. A peg tooth cultivator, a spring tine and a rigid tine cultivator were used. A description of the implements and their tillage action is omitted from the present summary.

At the first cultivation 6% only of the pupae were exposed by the peg tooth implement and 3% only by the other two. Frequency distributions of the depths at which pupae rested, carried out after the first operation, showed, however, in the case of the peg tooth implement, that 55% of the remainder had been lifted to within $1\frac{3}{4}$ inches of the soil surface, the depths ranging from $\frac{1}{2}$ inch to $1\frac{3}{4}$ inches, but mainly $\frac{1}{2}$ inch to 1 inch deep. In the cases of the other two, 30 to 33% of the remaining pupae had been lifted within 2 inches of the soil surface, but mainly about 1 inch deep. The superiority of the peg tooth implement in lifting up the pupae was confirmed in a second test.

Successive operations, made with a view to exposing pupae shown to have been raised nearer to the surface and to pull out deeper pupae, were fairly successful. After a series of tests it appeared that one initial stroke with a peg tooth cultivator followed by use of the rigid tine cultivator, at suitable intervals of time, for subsequent operations, gave best results. In the last experiment of this preliminary investigation three operations conducted at intervals of three weeks exposed 53% of the pupae inserted. In a field this would represent rather less than 26% of the pupae therein.

Investigations on the exposure of pupae by implemental means in different soil types are being continued, taking into consideration measures during the growth of the crop and also after harvest in order to reduce over-wintering pupae. Similar experiments on the exposure of pupae by ploughing and the action of a deep grubbing implement gave negative results.

Exposed pupae.—The fate of pupae exposed by implements, as in the above experiments, has been studied throughout, both in the open and when protected against ants, etc.

Pupae exposed during April, May and June for periods up to 54 days were not killed by heat, the highest temperature recorded at the soil surface being 117° F.

Hot weather and high evaporation were not experienced again until the following September. During this month temperatures at the soil surface were frequently between 130° and 138°. Pupae exposed to the sun were desiccated but those buried ½ inch below the soil surface were not killed, however.

Species of ants destroyed all exposed pupae within 2 to 3 weeks of the date of exposure except during June, July and August, when ants were inactive. Ants were active again in September, entering and destroying exposed pupae in a wholesale manner. Two of the species of ant concerned were *Pheidole capensis*, Mayr, and *Pheidole megacephale*, F. These are abundant in all the low veld cotton districts.

Cotton trap crops for Red Bollworm.—The nature and treatment of trap crop areas remains essentially the same as previously recorded. The trap crop measure as described, has been adopted by various cotton growers.

A high positive correlation has been found to exist between size of plant in the trap crop and eggs per plant. Size plus free fruiting in a plant was more attractive for egg deposition than size vegetatively. Small plants, sparsely fruiting and non-fruiting, definitely appeared to be avoided. For this investigation 1,000 plants were examined. These data and relative infestation records on trap and plant cotton plants appear to indicate that the trap exercises attraction for some time after the small plant cotton plants have produced buds.

Light Traps.—Acetylene flares of such candle power and cost per unit area as would not be prohibitive are ineffective. The following data serve to illustrate the unimportance of the influence exerted by a 75 c.p. flare as an attractant and trap for red bollworm moths, in terms of reduced oviposition.

With the flare as centre, four circles were marked off with radii of 50, 100, 150 and 200 feet. Some 200 plants were examined for eggs on the circumference of each circle after moderately high numbers of moths had been trapped at the light during a number of successive moonless nights immediately preceding. The oviposition records obtained from these plants for each circumference were as follows :— At a distance of 50 feet, 0·68 eggs per plant ; at 100 feet, 0·97 ; at 150 feet, 1·45, andat 200 feet, 2·00 eggs per plant. The rate of egg

deposition at 200 feet was equal to that in the remainder of the 10-acre field concerned and in outside control areas.

Paraffin lamps are less effective than acetylene flares, unless multiplied to an impracticable extent.

Light trap work has been discontinued until the part played by the ultra-violet portion of the spectrum has been investigated.

Pupation cage work.—Data on moth emergence behaviour throughout the year are being accumulated in this work which has been extended considerably. An improved type of cage is in use enabling field and climatic conditions to be more closely simulated.

Longevity and egg laying records of moths emerging a month prior to the appearance of buds on seedling cotton show that they are capable of ovipositing on the seedling cotton. If trap crop areas are present it appears that these early moths are attracted to and lay their eggs on the trap plants.

Season infestation records.—Weekly and bi-weekly counts of bollworm per plant were made at different points in the various districts throughout the season. These are the first systematic records to be compiled in the low veld areas and in each case show definitely, for the season 1930–31, an abrupt and extensive increase of infestation in the month of March. In previous years general observations had indicated that this increase occurred.

Parasite records.—An investigation on the presence, identity and abundance of species of parasites of the bollworm was undertaken in all the low veld districts last season.

The data are recorded on material systematically collected for the purpose. From these records the percentage of parasitism by all species found may be considered with reference to the actual infestation occurring at like times and not merely as the percentages of parasitism occurring in random collections of eggs and larvae.

Up to the present 13 egg parasites and 5 larval parasites have been recorded. One egg parasite, *Trichogramma lutea*, Girault, has been multiplied extensively in the laboratory and tested in preliminary experiments which are discussed briefly later. Nearly all the parasites collected remain unidentified.

AMERICAN BOLLWORM.

Work on the American bollworm problems commenced less than two years ago.

Infestations of cotton in the last year have rarely been widespread, rather, local and sporadic, and when they occurred they were generally most destructive. In the last two seasons the infestations have been

much less intensive on the whole, but more sustained and more widely experienced.

Up to the present, attention has been devoted mainly to the discovery of the sources of the infestations on cotton, records of parasite presence and activity, and to a study of moth emergence behaviour throughout the year, as indicated in the following paragraphs.

Infestation records.—Infestation records on cotton rotation crops, orchards and winter-irrigated vegetable crops commenced in the season 1929–30.

The American bollworm has been found to be active throughout the year.

Surveys in the last two years of winter season crops, and, on occasions, of citrus orchards, show that these are extensively infested and provide important data on the reservoirs from which the infestations on cotton are derived.

Pupation cage work.—This work commenced last season, particularly with reference to moth emergences in the winter season. Information on this point is desired in connection with winter and spring releases of two egg parasites.

Parasite records.—Records of the parasites found in material collected off cotton and rotation crops in the various districts and the percentages of parasitism occurring are being made, as indicated in the case of the red bollworm.

Considerable information of value on the presence and activity of egg parasites has been accumulated from material collected off winter crops.

Up to the present four egg parasites and six larval parasites have been recorded altogether. *Trichogramma lutea* and an unidentified chalcid egg parasite, which is temporarily designated parasite B, and a larval parasite *Sturmia inconspicua* have been of chief importance. Parasite B is active during the colder months.

Cotton Stainers.

A migration of stainers into the cotton fields commences as a rule in late February or early March. In the aggregate the numbers of stainers accumulating in an acre of cotton during this migration may be very large, but, owing to their dispersal throughout the area amongst the foliage, they are most inconspicuous and their presence may not be realized until after the peak of the migration is passed or until the progeny of the migrants are comparatively abundant. The persistence and magnitude of this migration of stainers and the damage occasioned by them, apart from their progenies, were measured during the past

season in connection with other data on wild host plants, seed trapping and hand collecting measures.

Practically all the invading stainers entered the fields of most advanced cotton only. These fields were taken for purposes of infestation records, commencing on March 9th. The following data serve to illustrate the magnitude of the invasion.

Date of record.	*Approx. no. of migrant stainers per acre.*
March 9th	180
14th	480
20th	4,800
25th	9,300
30th	10,980
April 4th	14,000

After April 4th the numbers fluctuated considerably. From the data secured as the result of efforts that were being made to judge of the persistence of the invasion by keeping native labourers constantly employed in collecting stainers by hand, it appeared that the migration period occupied 6 to 8 weeks.

The cumulative damage to the crop occasioned by migrant stainers, in the numbers indicated above, was measured by examinations of small, medium and large bolls, in quantities. The results are tabulated below.

Diameter of Bolls.	*Number Examined.*	*Mean No. of Proliferations per Boll.*	*Classification of Staining.*				
			Nil.	*Very Light.*	*Light.*	*Med.*	*Heavy.*
			(Nos. of bolls.)				
33–39 mms. ...	100	29·6	7	10	18	31	34
29–32 mms. ...	100	10·6	25	16	33	15	11
20–28 mms. ...	100	1·88	73	16	9	2	0

The number of migrant stainers was probably greater than usual, judging from the unusually large numbers that were seen ultimately, as successive broods developed. Probably equally large invasions, however, have been experienced in some years. Staining was certainly heavier than any experienced heretofore at the Cotton Breeding Station. It is quite evident that the comparatively unobserved migrant stainers are capable of ruining a crop.

Cotton seed traps and hand collecting methods, even when prosecuted much beyond the limits of economic possibility, were found to be quite useless in coping with the migrant stainers and of unimportant value in dealing with the progeny, at least until the plants had ripened off considerably. When nothing but fruited bolls remained on the plants stainers congregated in masses on cotton seed and crushed cotton seed heaps, as observed by other workers.

It appeared that stainers could be destroyed wholesale on seed heaps placed in the fields when the last bolls were ripening off, and if a cheap, rapid and effective method of destroying them could be devised, destruction on seed heaps might be regarded as a substitute for, or accessory to, close season measures, but more as a substitute than as an accessory, since a close season as generally understood is frequently not applicable owing to the erratic nature of the seasons.

Seed poisoned with various strengths of sodium arsenite and sodium fluoride was avoided by stainers.

As a result of a series of tests of various spray materials, it was found that one ounce of common laundry soap emulsified in a gallon of water provided a highly effective spray. This was sprayed forcibly on to the masses of adult and nymphal stainers which congregated on seed heaps, using a cheap bucket pump inserted in a tub containing the emulsion, carried on a wheelbarrow. Approximately 6 lbs. of cotton seed were used per heap, the seed being spread out to form a circle about 18 inches in diameter and about 2 inches deep in the centre. This proved to be the most suitable size of heap, giving less wastage of spray and a more rapid and concentrated attack on the insects. Three pints of spray per heap sufficed as a rule, the mortality being about 80%, allowing for recoveries. Five seed heaps per acre were laid down. Two native labourers sprayed 500 heaps or 100 acres in a day, the cost of a spray all told being about a halfpenny per acre, providing the soap was purchased in 100 lb. lots. During hot sunny days the spray was directed mainly on to two or three plants near the seed heaps, rather than on to the heaps themselves, as stainers sought the shade between 10 a.m. and 3.30 p.m. The amount of spray used on sunny days was somewhat larger. Twelve sprayings at 4- to 6-day intervals were given throughout the off season months. The number of stainers killed on 30 heaps or from 6 acres was measured on one occasion by collecting all dead stainers, weighing them, after sun drying, and computing the number collected by reference to weighed and counted samples, drawn from them. There were 105,000 stainers killed on these few heaps by one spraying. The reduction of stainers per acre following each spray was measured by taking counts over fields by means of a light transportable cage 6 feet square, within which the stainers found were counted over 20 or more positions in a field. The stainer population dropped from 53,000 per acre on August 7th to 2,000 per acre on September 1st. On this date the cotton was cut, raked into heaps, and burned a few days later. Spraying heaps was continued after the burning of cotton until stainers practically disappeared. In unsprayed fields the stainer population waxed and waned markedly

and a continual exodus into the veld of adult stainers on the wing was noted.

It was not found necessary to renew the seed heaps. This method of destroying stainers may be of some value if it is found that our migrant stainers are derived from local or semi-local sources. The soap emulsion spray was highly effective when applied as a forcible contact spray but not so when applied as a finely divided or mist spray on seed heaps or amongst cotton plants. Different sprays with cheap soaps varied considerably in effectiveness.

Parasites of the Stainer.—Four Tachinid parasites of the stainer were found during the season. They have not been identified. Only 800 stainers out of about 60,000 stainers examined over a period of three months were found to be parasitized.

PARASITE BREEDING WORK AND LIBERATION EXPERIMENTS.

This work, up to the present, has been mainly concerned with the mass production and liberation of the egg parasite, *Trichogramma lutea*, Girault. Actually some eight millions of parasites were bred in the laboratory, about two-thirds of which were utilized in preliminary release experiments. An account of the past season's work in this connection had been prepared for insertion in the present Report, but owing to limitations of space has been withdrawn. A few observations may be made, however, as follows.

Results in regard to the red bollworm egg were not encouraging. Data showed that approximately 90% of the red bollworm eggs were laid on positions on the plant where the development of hairiness was most considerable. Observations of the parasites' behaviour in regard to eggs deposited at these hairy sites indicated that they were unable to get at or were deterred from getting at eggs laid amongst hairs when the density of these was relatively extensive.

Results in regard to the American bollworm egg on cotton were encouraging, possibly because the great majority of these were found on leaf surfaces or other less hairy surfaces. Good results were also obtained in the parasitism of American bollworm eggs on maize, soya bean and other bean crops.

FIELD EXPERIMENTAL WORK ON ROTATION CROPS.

BY

W. L. FIELDING.

The range of crops under consideration remains as last year. Except where data are noted as being of a purely observational character, all inferences are the result of analysis of data, by Fisher's Variance

method, from trials laid out on accepted randomized block principles, with four repetitions per treatment.

Germination was good, and crops looked vigorous vegetatively during growth, but the sharp closing in of the rainy season resulted in poor filling out of grain, whilst in later planted bean crops actual production of flowers and pods was poor. White ant depredations considerably hampered plot work.

Soy Bean (*Glycine max.*).

Variety Test.—This has shown the advisability of eliminating all but the strains resistant to shattering, Yellow 1 and Yellow 2, from serious consideration as grain yielders. The varieties Morse and A.K. may prove of use as green manuring or as forage crops and will be tried in this respect against Yellow 1 in the coming season.

Combined Time of Planting, Inter-row Spacing Test (observation plots in duplicate only).

Plantings were made on three separate dates, a pair of plots planted at 2 feet 8 inches between rows, and a pair drilled in at 12 inches between rows being put in on each occasion.

Outstanding in the results was an extremely large increase of produce return per unit area, in favour of the closely drilled, as opposed to the widely spaced crop ; actual differences in yield per acre being 545 lbs., 195 lbs., and 220 lbs. for the three plantings. This opens up the possibility of drilling in a Soy bean crop, with a ten or twelve coulter grain type drill, as an economic proposition. The question will be further investigated in the coming season.

Inter-plant Spacing Test.—Spacings of 6, 8 and 10 inches between plants in the row were tried, inter-row spacing being 2 feet 8 inches throughout. Treatment effect was insignificant, and the trials will be repeated with the inclusion of a 4-inch inter-plant spacing.

Combined Fertilizer and Inoculation Test.—The test was primarily designed to gain some information as to the extent of the influence of potassium and phosphorus, with and without lime, on nodule formation. Lime appeared to have a strongly significant beneficial effect on vegetative growth, nodulation, white ant resistance and ultimate yield. All other effects and interactions were insignificant.

Multiplication.—The Yellow 1 and Yellow 2 strains have been multiplied for purposes of distribution and further trials.

Tepary Bean (*Phaseolus acutifolius*).

Combined Time of Planting, Inter-row Spacing Test (observation plots in duplicate only).

Plantings were made on three separate dates, a pair of plots planted at 2 feet 8 inches between rows, and a pair drilled in at 12 inches between rows being put in on each occasion. There was no appreciable difference in yield between plots sown in rows 2 feet 8 inches apart, and those drilled in at 12 inches spacing between rows. Yields ranged from 1,600 lbs. per acre for the early (late December) plantings to 400 lbs. per acre for the last (late February) plantings.

Inter-plant Spacing Test.—A 10-inch spacing treatment gave a significantly lower yield than a 6-inch and 8-inch treatment. The distance between the rows was 2 feet 8 inches. This would indicate the desirability of trying a yet closer spacing, and a 4-inch treatment will be included next season.

LIMA BEAN (*Phaseolus lunatus*).

The chief point of interest was the absence of green pod shedding which in previous years has been responsible for considerable loss of potential grain. In July, 1930, Lima beans were quoted at £32 per long ton, afloat; in June, 1931, at £20, the lowest quotation during the intervening period being £17 10s. 0d. in February, 1931.* Seed having been multiplied, a more extensive experimental programme with this crop, which commands a higher monetary value on export markets than other beans, will be possible next season.

SUNFLOWERS.

The following facts have again emerged, confirming last season's results.

1. Equal yield per acre from a 30-inch inter-plant spacing in the row, compared with 24-inch and 18-inch inter-plant spacings.
2. The total area of sunflower heads increases directly with the inter-plant spacing distance (up to a spacing of 30 inches, the greatest inter-plant distance so far tested).
3. The percentage of infertile central area of sunflower heads decreases with increased spacing between plants in the row, (up to the 30-inch spacing as in 2 above).

The results are important economically, leading to a possible saving in seed and reduction in thinning and harvesting costs.

A field crop of a black strain (B.6) yielded at the rate of 1,400 lbs. per acre. This, whilst allowing of a profit, is low in comparison with previous seasons.

* "London Grain, Seed and Oil Reporter."

Variety Observation Test.—The test has resulted in the retention of the following range for further study, selection and multiplication.

Range of Sunflower Strains.

Strain.	*Type.*	*Maturation Period Days.*
W 1	Large White, Early ...	120–130
St 3	Large Striped, Early ...	120–130
B 4	Small Black, Medium early	140–150
B 2	Small Black, Late	160
B 6	Small Black, Late	160

Groundnuts.

For the third year in succession "rosette" disease has been negligible. Moreover an extremely good bulk stand of the Barberton strain (re-named from an original lot of Gudiatham) was obtained. Although in the past losses due to "rosette" have been reported from the area, the above seems to indicate that serious consideration should be given to groundnuts as a rotation crop. A more extensive programme has been planned for next season. A variety trial of the three varieties retained last year gave the following results:— Barberton strain yielded at a rate of 1,600 lbs. per acre, Spanish 9 at 1,500 lbs., and Japanese at 1,200 lbs. These yields compare very favourably with yields obtained elsewhere in South Africa.

Maize.

An extensive range of varieties of maize was planted out on two separate planting dates. Careful observation of general plant characters, growth period, streak resistance, etc., aided by yield estimates has resulted in the retention of certain varieties for inclusion in trials next season, grouped under three heads, early, medium, and late maturing.

The importance of getting maize in moderately early so that it may have full benefit of the rains and be given every chance of maturing fully-formed cobs has again shown up in the difference between moderately early and later plantings; the crop from the latter being more or less a complete failure compared with the very reasonable yields from the earlier planting.

A variety of maize known as Peruvian Yellow has shown promise. This produces a small red-yellow grain which is reported to be well suited to export market requirements. American White Flint, which gave the highest return last season, was again superior to others, except certain varieties whose long maturation periods make them of doubtful value.

WEDGE-PEA (*Lathyrus Sativus spp.*).

The grain from this plant resembles most closely the Riga pea sheep's tooth or dog's tooth pea). Advices regarding prices from London, based on current quotations for Riga peas, indicate that the production of grain from this plant for export would be uneconomic. Apart from the rotational aspect, certain characteristics bring the crop within the bounds of possibility as a fodder crop. These are its drought resistant properties, growth period of 140 days, and apparent immunity from insect attack.

By arrangement with the Division of Veterinary Services, Pretoria, a definite feeding trial will be carried out at the Onderstepoort Station. The crop will again be grown on a field scale at Barberton in the coming season, with a view to aiding Onderstepoort in the supply of material for the feeding experiment.

The crop gave a greater yield, both of hay and of grain per acre when drilled in at 12 inches between rows, than when sown in rows 2 feet 8 inches apart.

SORGHUM FOR SILAGE PURPOSES.

A white grain sorghum, commonly called Mapira, was planted for silage purposes. The crop drilled in at 2 feet 8 inches between rows yielded only 5 tons green matter per acre, compared with 8 tons per acre from a broadcast crop. The crop was sown late on account of delayed rains. This variety of sorghum seems to be the most suitable type for silage production, so far as yield is concerned. The inadequate rains of the year again resulted in a poor veld for winter pasturage. The provision of pit silage has, in consequence, again made it possible to bring the trek oxen through to late winter in good condition for spring work.

BARBERTON.

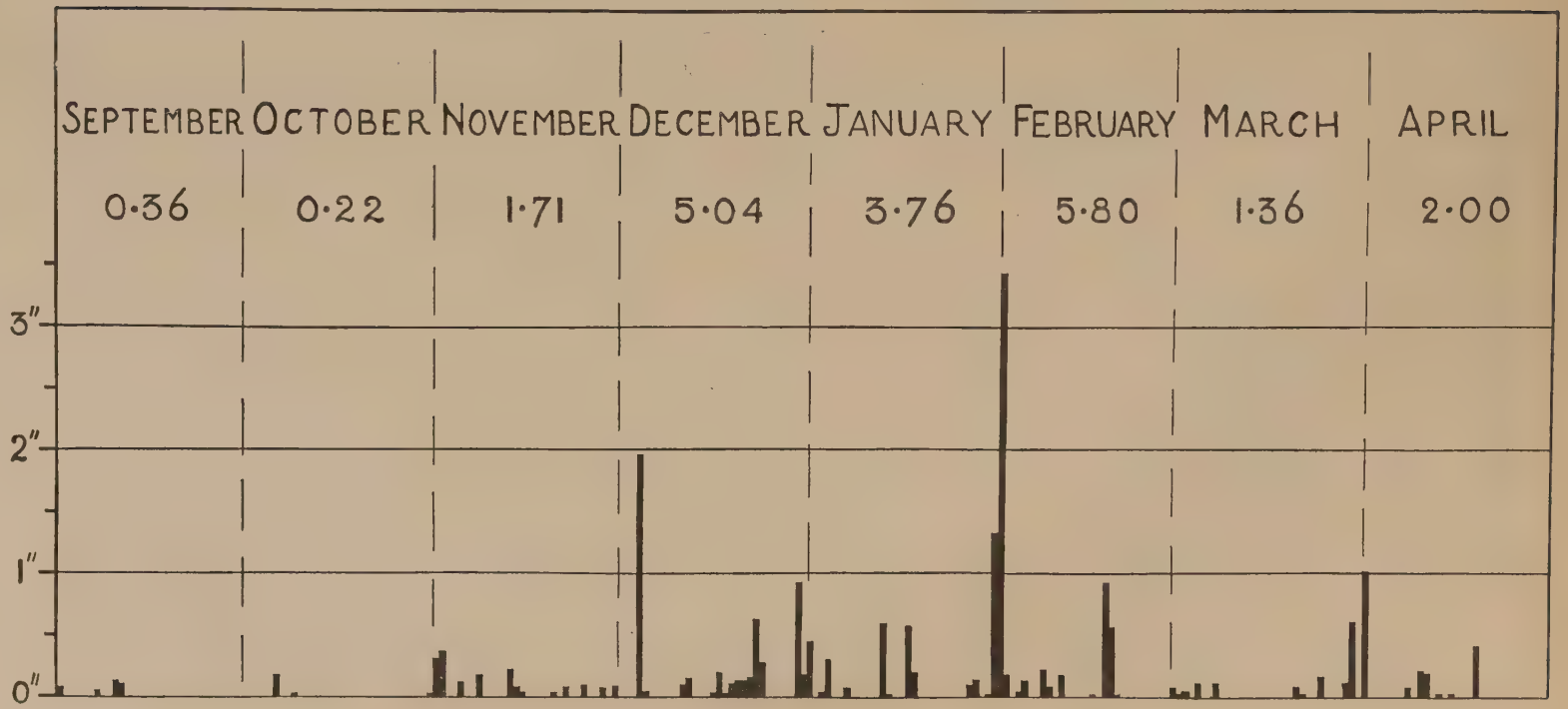
Daily Rainfall, Season 1930–31.

	July.	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May.*	*June.*
1	—	—	0·08	—	0·31	—	0·45	3·44	0·08	1·02	—	0·03
2	—	—	—	—	0·37	—	—	0·18	0·02	—	—	0·04
3	—	—	—	—	—	—	0·03	—	0·04	—	0·01	—
4	—	—	—	—	—	1·97	0·29	0·05	—	—	—	—
5	—	—	—	—	0·12	0·04	—	0·13	0·11	—	—	—
6	—	—	—	0·18	—	—	—	—	—	—	—	—
7	—	—	0·05	—	—	—	0·06	—	—	—	—	—
8	—	—	—	—	0·18	—	—	0·21	0·11	0·08	—	—
9	—	—	—	0·01	—	—	—	0·08	—	—	—	—
10	—	—	0·13	—	—	—	—	—	—	0·22	—	—
11	—	—	0·10	—	—	0·09	—	0·18	—	0·21	—	—
12	—	—	—	—	—	0·15	—	—	—	—	—	—
13	—	—	—	—	0·22	—	0·59	—	—	0·02	—	—
14	—	—	—	—	0·09	—	0·01	—	—	—	—	—
15	—	—	—	—	0·03	—	—	—	—	0·02	—	—
16	—	—	—	—	—	0·02	—	0·01	—	—	—	—
17	—	—	—	—	—	0·20	0·56	—	—	—	—	—
18	—	—	—	—	—	0·03	0·20	0·94	—	—	—	—
19	—	—	—	—	—	0·11	—	0·56	—	0·43	—	—
20	—	—	—	—	0·04	0·13	—	0·02	—	—	—	—
21	—	—	—	—	—	0·13	—	—	0·08	—	—	—
22	—	—	—	—	0·09	0·17	—	—	0·01	—	—	—
23	—	—	—	—	—	0·63	—	—	—	—	—	—
24	—	—	—	—	—	0·27	—	—	—	—	—	—
25	—	—	—	—	0·10	—	—	—	0·17	—	—	—
26	—	—	—	—	—	—	—	—	—	—	—	—
27	—	0·09	—	—	—	—	0·09	—	—	—	—	—
28	0·25	—	—	—	0·07	—	0·14	—	—	—	—	—
29	—	—	—	—	—	—	—	—	0·12	—	—	—
30	—	—	—	—	0·09	0·93	0·01	—	0·62	—	—	—
31	—	—	—	0·03	—	0·17	1·33	—	—	—	—	—
Total ...	0·25	0·29	0·36	0·22	1·71	5·04	3·76	5·80	1·36	2·00	0·01	0·07

Total rainfall for year 20·87 inches.

BARBERTON.

DAILY RAINFALL . SEASON 1930-31 .



APPENDIX.

Growth Curves, and Co-ordination between Stations.

BY

O. V. S. HEATH.

At the Conference on Cotton Growing Problems held at Didsbury in 1930, Dr. E. J. Maskell, discussing the possibilities of co-ordinating growth and development data from different Experiment Stations, said : " If you can get the development curves into the form of a few figures, or constants, then it may be more easily possible to compare the curve from one place with the curve from another place, and relate the changes to changing intensity of environmental factors."* With this idea in mind the growth data for the last three seasons have been examined. After the date of opening of the first flower the time curves for height of main stem show considerable variation in general form, no doubt mainly owing to differences in the amount of shedding due to bollworm and other external factors. It would seem that in order to fit equations to the time curves of height of main stem for the whole period up to cessation of growth, it would be necessary to use empirical polynomials. These would differ considerably from Station to Station and from year to year, and comparisons would be difficult. If, however, we examine the time curves for height up to the time of the first flower only, it is found that in every case the curve is very approximately an exponential one (*i.e.*, of the " compound interest " type). This is shown by the fact that the logarithms of the heights plotted against time give an approximation to a straight line, from the time when it is convenient to begin measuring (*i.e.*, 10 or 12 cms. height) up to the time of the first flower. This can be seen in Figs. 2 and 3, where the logarithms of the heights, and also the actual heights, of cotton plants measured 2-daily during the last three seasons are shown plotted against time. Exponential equations have been calculated by the least square method to give the best fit to the observed height curves. These equations take the form

$$H = Ae^{bT}$$

where H=height in cms. ; A=a constant (the theoretical height at time of germination) ; e=the base of Naperian logarithms ; T=time in days from germination ; and b=the relative growth rate per day (*i.e.*, the increase in height per day per cm. of height already attained). Following the suggestion made by Maskell,† the date of germination has been taken as the date when 50 per cent. of the plants appeared.

The calculated curves are shown in Figs. 2 and 3. The equations are shown in Table II, together with the standard deviation of *b* in

* Report and Summary of Proceedings. Conference on Cotton Growing Problems, 1930, p. 105.

† *Ibid.* p. 102.

each case and the limits within which b could vary without the deviation being significant (20 : 1 chance). In order to prevent the table from becoming unwieldy the standard deviation of H (the height at any time T) is omitted. This standard deviation is found by making use of the deviations of the observed from the calculated values of H. It varies from 1·1% of the mean of the observed heights in the case of the Z.1/9 in 1928–29 to 4·7% of the mean in the case of the U.4/2 in 1930–31. It will be seen from the table that the number of observations included in the portion of the curve fitted varies from 18 to 23. Therefore the number of "degrees of freedom" available for finding the standard deviations varies from 16 to 21, since there are two constants in the equation calculated from the data.

TABLE II.

EXPONENTIAL HEIGHT CURVES UP TO TIME OF FIRST FLOWERS (2-DAILY OBSERVATIONS).

Season.	*Variety.*	*Number of observations n′.*	*Equation* $H=Ae^{bT}$	*Relative growth rate* b.	*Standard deviation of* b.	*Significant deviation in* b‡. (P=·05)
1928–29 ...	Z.1/9	23	$H=5{\cdot}039e^{\cdot 0320T}$	·0320	·00028	·00058
1929–30 ...	U.4/2 (M.W.)*	18	$H=3{\cdot}850e^{\cdot 0355T}$	·0355	·00034	·00072
1929–30 ...	U.4/2 (M.S.)†	18	$H=4{\cdot}197e^{\cdot 0331T}$	·0331	·00071	·00150
1930–31 ...	U.4/2 920SB	21	$H=4{\cdot}896e^{\cdot 0419T}$	·0419	·00104	·00217

It is suggested that if other Stations will give the exponential equations for the time curves of height of main stem up to the date of first flowering, always assuming that these fit satisfactorily, comparisons of great interest will be possible. The constant b is the most important feature of the equation, giving as it does a measure of the plant's efficiency in terms of stem production during the very important growth period up to the beginning of flowering. Thus, glancing at the above Table, one sees that in 1930–31 the U.4/2 produced main stem at the rate of 4·2% of its height per day during this period of growth. In 1929–30 on the "Mealies Spring" treatment (which is comparable with the treatment of the 1930–31 land) the rate of production was only 3·3% of the height. The high relative growth rate in 1930–31 may be correlated with the very late start of the season followed by favourable conditions for growth. It should be pointed out that the

* "Mealies Winter" treatment
† "Mealies Spring" treatment } *see* p. 50 Report for 1929–30.

‡ Significant deviation in b is the standard deviation of b multiplied by the appropriate value of t (*see* Fisher—"Statistical Methods for Research Workers") for P=·05 and $n=n'-2$.

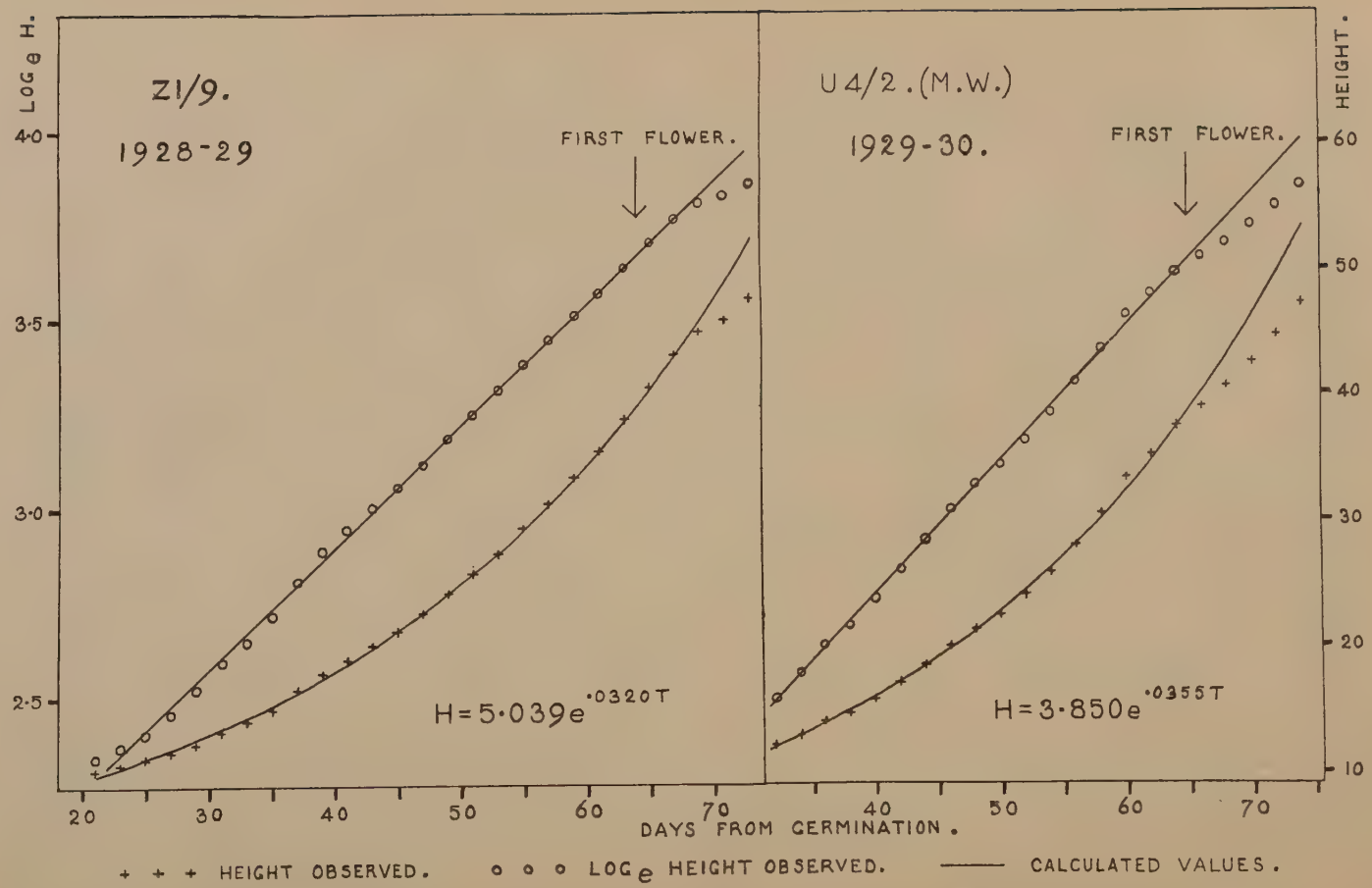


FIG. 2. EXPONENTIAL CURVES FOR HEIGHT OF MAIN STEM.

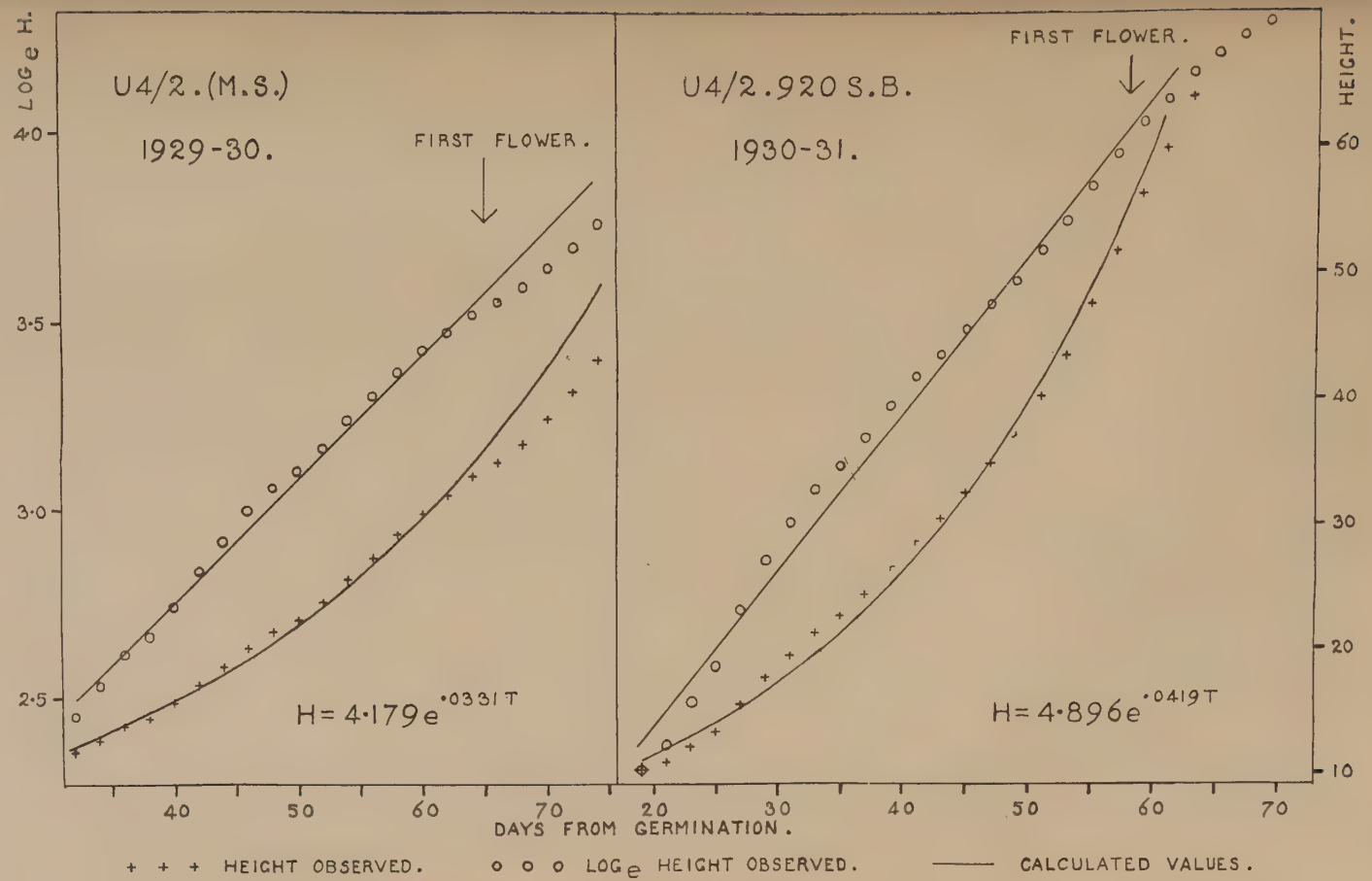


FIG. 3 . EXPONENTIAL CURVES FOR HEIGHT OF MAIN STEM .

relative growth rate b is similar to Blackman's "efficiency index" r, § the latter being the relative rate of growth in terms of dry weight. As Blackman points out: "The term r is an important physiological constant, for it is a measure of the efficiency of the plant in the production of new material; the greater r is, the higher the return which the plant obtains for its outlay of material." Dry weight provides a much better measure of growth than height of main stem and it is hoped to carry out dry weight determinations in the coming season. Many Stations, however, are not able to deal with dry weight determinations, and since height of main stem must be highly correlated with dry weight for the growth period dealt with, the comparison of height curves would appear to be useful. The constant A is the value of H given by the equation for T=O, *i.e.*, for the date of germination. The fact that A is always too high shows that the cotton seedling in its initial growth in height does not grow according to the exponential curve, but at a higher rate. This is doubtless because it is utilizing supplies stored in the seed and has in the cotyledons a certain leaf area, so to speak ready-made, independent of the height. If A is much larger than usual it indicates that very rapid growth took place in the initial stages; if much smaller, that the seedlings made an abnormally slow "get-away."

It is of course possible to make use of weekly data instead of 2-daily data as has been done above. In this case there is a great reduction in labour, both of measurement and of calculation, but there is also a considerable loss of accuracy. In order to illustrate this, the curves have been re-calculated from the same data making use of every fourth observation, *i.e.*, 8-daily intervals. The results are shown in Table III.

TABLE III.

EXPONENTIAL HEIGHT CURVES UP TO TIME OF FIRST FLOWERS (8-DAILY OBSERVATIONS).

Season.	*Variety.*	*Number of observations* n′.	*Equation* $H=Ae^{bT}$	*Relative growth rate* b.	*Standard deviation of* b.	*Significant deviation in* b‡. (P=·05)
1928–29 ...	Z.1/9	6	$H=5{\cdot}236e^{\cdot 0312T}$	·0312	·00076	·00211
1929–30 ...	U.4/2 (M.W.)*	5	$H=3{\cdot}862e^{\cdot 0354T}$	·0354	·00041	·00130
1929–30 ...	U.4/2 (M.S.)†	5	$H=4{\cdot}049e^{\cdot 0337T}$	·0337	·00156	·00496
1930–31 ...	U.4/2 920SB	6	$H=4{\cdot}829e^{\cdot 0421T}$	·0421	·00172	·00477

* "Mealies Winter" treatment
† "Mealies Spring" treatment
see P. 50 Report for 1929–30.

§ V. H. Blackman. "Annals Botany," XXXIII, 1919, pp. 353–360.

‡ *See* Footnote p. 29.

It will be seen that the limits within which b can vary without the deviation being significant are very much wider than in the case of the 2-daily observations. Not only is the estimate of the standard deviation of b somewhat larger but it is much less reliable, being based on a smaller number of observations. It has therefore to be multiplied by a larger value of t (as given in the table in Fisher's "Statistical Methods for Research Workers") in order to arrive at the significant difference in b.

A method of evaluating the constants, less laborious but less accurate than that of least squares, is the graphical method. If $\log_e H$ is plotted against time a straight line is obtained which has the equation

$$\text{Log}_e H = \text{Log}_e A + bT$$

This is the equation arrived at by taking Naperian logarithms of both sides of the equation

$$H = Ae^{bT}$$

If therefore we plot Naperian logarithms of the observed heights against time, and draw by inspection the straight line giving the nearest fit for the period up to the beginning of flowering, b will be the slope of the line, *i.e.*, the increase in value of $\text{Log}_e H$ per day. To find A we produce the straight line back to $T=0$, when the intersect on the y axis will be $\text{Log}_e A$.

The simplest method of finding the average relative growth rate per day for any period is to find the difference between the Naperian logarithms of the heights at the beginning and end of the period and divide by the number of days. In the present case, however, there is the danger that the initial and final heights taken may lie off the exponential curve, *e.g.*, the first measurement may have been made before the plant began to grow logarithmically, or the relative growth rate may already have begun falling off on the date of first flowering. For the purpose of obtaining comparable results from different Stations it would appear preferable to find b by fitting an exponential curve to the height data up to the time of first flowering. In this case if the initial or final points do lie somewhat off the curve the result will not be affected to such a great extent. It might be of interest if Stations were to give also the average relative growth rate per day from the date of first measurement up to the date of cessation of growth. This might be presented, together with the initial and final heights, in a table such as Table IV.

TABLE IV.

Season.	*Variety.*	*First measurement in cms.* $=H_1$.	*Final height in cms.* $=H_2$.	*No. of days* H_1 to H_2 $= n'$.	*Average relative growth rate per day* $\dfrac{\log_e H_2 - \log_e H_1}{n'}$
1928–29 ...	Z.1/9 ...	10·4	126·8	140	·0346
1929–30 ...	U.4/2(M.W.)	12·1	87·6	114	·0174
1929–30 ...	U.4/2(M.S.)...	11·6	91·8	114	·0182
1930–31 ...	U.4/2 920SB	10·0	95·8	80	·0282

Such results would require interpretation in the light of shedding, flowering, and bolling data. For instance, in the case of Z.1/9, 1928-29, the high efficiency from the point of view of stem production and the great height attained, were associated with a high rate of shedding and a low rate of flowering.

These questions have been dealt with in some detail here, instead of being deferred until the next full Report from this Station, as it is felt that the sooner an attempt is made at co-ordinating growth and development data from different Stations the better. It is realized that the above suggestions only represent a very small beginning, and that methods for co-ordinating flowering and bolling data, etc., are even more necessary, but it is hoped that they may prove a step in the right direction. The writer would be very glad to enter into correspondence with workers at other Cotton Experiment Stations or elsewhere with regard to these topics.

SWAZILAND

REPORT ON THE WORK OF THE COTTON EXPERIMENT STATIONS AT BREMERSDORP AND INGWAVUMA FOR THE SEASON 1930-1931.

Summary of Results.

BY

J. V. LOCHRIE.

General.

Climatic Conditions.—The season has been a very short one, characterised by the late arrival of the rains and by prolonged periods of drought during the growing season. Falls of rain were very local and the two Experiment Stations were fortunate in receiving well over the season's average rainfall. The amounts shown in the rainfall chart by no means represent the conditions generally ; the average for the whole of the area in which cotton was grown was in the region of 16 inches and in addition the distribution was unfavourable.

The bulk of the land in the mid-veld area, of which the Bremersdorp Station is representative, could not be ploughed in winter owing to lack of rain. In the season under review no falls of any value were received until November 1st and the necessary preparation of the land had to be done then. In normal seasons planting is well advanced by that date. In the low veld areas ploughing had been completed during the winter, but there the rains were even later in arriving, with the result that planting all over the country was very much delayed. This delay had two important effects on the final crop returns (*a*) the proposed acreage was considerably reduced and (*b*) much of the plantings were put in too late to be of any great value unless the growing season were prolonged. Unfortunately the season closed very early, and the

effect of this on the later plantings combined with drought in the growing season and an increase in bollworm attack from mid-February led to low average yields.

In one area where a considerable acreage of cotton was grown under irrigation encouraging yields were obtained in spite of heavy bollworm loss.

Pests and Diseases.—Except for parts of South Swaziland, the incidence of the various bollworms was not great as far as numbers were concerned, but the losses assumed a relatively higher importance due to the poor chances of recovery of the plants in the unfavourable water conditions. American Bollworm (*Chloridea obsoleta*) was present early in the season, but Sudan Bollworm (*Diparopsis castanea*) was of much greater importance this year. In general, the attack was slight in the early stages of the crop, developing in intensity during February and early March. This comparative immunity in the early stages and the poor conditions of growth later led to an early and short picking period.

Jassid was of negligible importance and Aphis, which was general during January, disappeared following the February rains.

Stainer (*Dysdercus spp.*) appeared in all areas by the middle of March, but, owing to the quick finish of the season, the damage was slight. However, enough was seen on certain crops which had matured late to emphasize the importance of this pest in longer growing seasons. The later pickings from these crops were stained and a high percentage of green bolls examined in late April and in May showed the effect of stainer punctures.

Development of Stations.—It was mentioned in the Report of the previous season that Cotton Plantations Ltd. had installed a pumping plant on the Ingwavuma River with a view to irrigating part of the crop, and had kindly offered to supply free the necessary land, labour and water for experimental plots. A block of about 15 acres was chosen and the Company had this area fenced and a small shed erected for storage purposes. The work this year was confined to the planting of a range of strains of U.4 cotton and of various rotation crops for observation purposes. As noted elsewhere in this report, the spacing employed appeared to be too close and it is intended to carry out a Spacing Experiment in the coming season. An experiment with various amounts of water and times of application will also be carried out.

The yields of cotton obtained, though not high, were greatly in excess of those from adjoining "dry land" cotton, while some of the rotation crops grown showed considerable promise.

Experimental Stations.

Bremersdorp.—The total rainfall recorded for the period September to July was 21·84 inches which is roughly two thirds of the normal. The first effective rain fell on November 1st, and the ploughing of the station land was commenced. Fortunately the station had been equipped with implements and oxen and the preparation of the area for cotton was soon completed. Some favourable falls of rain were received and the whole of the cotton was planted by November 23rd. Germination was good and the rains which followed, though slight, were well distributed, and the plants did not suffer from lack of moisture in the early stages of growth. The crop held on well during the dry period in January, flowering was profuse following the excellent rains in early February, and with a continuance of high temperatures, the prospects were very encouraging. With the exception of two good falls in March, no further rain of value was received and this was reflected in the growth of the bigger growing, later strains. These did not make the growth expected and it is considered that the climatic conditions, added to the freedom from early bollworm, favoured the early strains.

By the end of March the first plantings were beginning to open and all flowering had practically ceased early in April, owing to water shortage and to the fact that the plants were already carrying a good crop.

The average outturn over the station was 1,000 lbs. seed cotton per acre, a very satisfactory yield considering the season. This yield is accounted for by the comparative absence of early bollworm and by the high temperatures which enabled the crop to mature before the arrival of stainer.

Ingwavuma.—The rainfall on the station was 24·23 inches which is slightly in excess of that of the two previous years. Excellent rains fell towards the end of November and the whole acreage was planted at once. Good stands were obtained, but a severe windstorm in mid-December did considerable damage and the Variety Trials had to be re-planted. The rest of the cotton on the station, though the plants were not killed, received a severe set-back which was reflected in the rather slow growth of the plants and in the final yields. The persistent drought which commenced in January and, but for two falls in February, continued right on to nearly the end of March prevented the crop from making up the leeway. Bollworm was present throughout the season but the infestation was never particularly heavy on the station.

Variety Trials.

Seventeen of the newer selections from Barberton were chosen for trial together with U.4 bulk, U.4/4 and U.4/2. Three trials, each of which included 12 of the above 20 lots, were planted, the group arrangement being such that each strain was included as far as possible in two trials while U.4 bulk appeared in all three.

Plots were replicated four times in randomized blocks and the whole experiment was carried out at both stations.

Bremersdorp.—The plots were planted during the third week in November and good stands were obtained. Little bollworm loss was experienced and, but for the shortage of rain, the crop had excellent conditions.

Ingwavuma.—The first planting was completed by November 30th but owing to a sandstorm the plots had to be replanted on December 22nd. The stands were good as also was the subsequent growth despite the long dry spell. Bollworm attack was slightly heavier than on the Bremersdorp station.

Table I gives the yields in lint per acre and also the lint characters.

TABLE I.

Variety Test 1.	*Bremersdorp.*		*Ingwavuma.*		*Lint Characters. Mean of both Stations.*	
Strain.	*Lint yield lbs. per acre.*	*Difference from mean.*	*Lint yield lbs. per acre.*	*Difference from mean.*	*Lint Length. mms.*	*Ginning percentage. Commercial.*
9275 ...	435	+58	319	−41	31·5	32·4
920 ...	415	+38	343	−17	30·5	33·0
H.7 ...	403	+26	366	+ 6	29·5	34·4
9243 ...	398	+21	415	+55	30·3	35·3
U.4/4 ...	394	+17	378	+18	30·4	34·2
921 ...	389	+12	324	−36	31·2	34·7
U.4 ...	368	− 9	383	+23	29·4	34·8
9355 ...	363	−14	428	+68	31·4	32·5
9331 ...	347	−30	324	−36	29·8	33·0
U.4/2 ...	341	−36	352	− 8	29·8	32·8
9292 ...	333	−44	324	−36	29·9	31·6
9241 ...	332	−45	360	—	30·2	29·8
Mean ...	377		360			

Standard Error of difference between two strains { Bremersdorp 35·7 / Ingwavuma 36·8

Difference required for significance (P=·05) ... { Bremersdorp 70·0 / Ingwavuma 72·0

Variety Test 2.	*Bremersdorp.*		*Ingwavuma.*		*Lint Characters. Mean of both Stations.*	
Strain.	*Lint yield lbs. per acre.*	*Difference from mean.*	*Lint yield lbs. per acre.*	*Difference from mean.*	*Lint Length. mms.*	*Ginning percentage. Commercial.*
9275 ...	495	+105	257	−53	31·5	32·4
9243 ...	457	+ 67	392	+82	30·3	35·3
9149 ...	415	+ 25	270	−40	29·5	32·5
920 ...	404	+ 14	360	+50	30·5	33·0
H.7 ...	400	+ 10	338	+28	29·5	34·4
9312 ...	379	− 11	378	+68	29·5	33·0
955 ...	374	− 16	374	+64	31·3	35·6
9232 ...	372	− 18	293	−17	30·5	32·8
913 ...	363	− 27	221	−89	30·3	32·1
928 ...	346	− 44	311	+ 1	30·8	33·8
U.4 ...	345	− 45	252	−58	29·4	34·8
9274 ...	328	− 62	275	−35	30·3	32·2
Mean ...	390		310			

Standard Error of difference between two strains { Bremersdorp 30·3 / Ingwavuma 37·4

Difference required for significance (P=·05) ... { Bremersdorp 59·8 / Ingwavuma 73·2

Variety Test 3.	*Bremersdorp.*		*Ingwavuma.*		*Lint Characters. Mean of both Stations.*	
Strain.	*Lint yield lbs. per acre.*	*Difference from mean.*	*Lint yield lbs. per acre.*	*Difference from mean.*	*Lint Length. mms.*	*Ginning percentage. Commercial.*
921 ...	372	+45	275	+ 3	31·2	34·7
9312 ...	356	+29	283	+11	29·5	33·0
9355 ...	352	+25	275	+ 3	31·4	32·5
9292 ...	337	+10	257	−15	29·9	31·6
998 ...	333	+ 6	265	− 7	30·7	33·1
9149 ...	327	—	252	−20	29·5	32·5
U.4/4 ...	324	− 3	275	+ 3	30·4	34·2
U.4/2 ...	322	− 5	293	+21	29·8	32·8
9331 ...	312	−15	275	+ 3	29·8	33·0
955 ...	305	−22	315	+43	31·3	35·6
U.4 ...	302	−25	243	−29	29·4	34·8
9232 ...	286	−41	252	−20	30·5	32·8
Mean ...	327		272			

Standard Error of difference between two strains { Bremersdorp 32·4 / Ingwavuma 33·2

Difference required for significance (P=·05) ... { Bremersdorp 63·5 / Ingwavuma 65·0

The strains planted in the Variety Trials comprised a range of types varying in habit and earliness. At both Stations the season was short and the larger types did not make the growth expected, while the early strains, particularly at Bremersdorp, closed down early. Comparing the results of the two Stations as a whole, there is a definite similarity in the performance of the various strains under the two sets of conditions. With the marked exception of strain 9275

which, at Ingwavuma, never appeared to recover from an early bollworm loss, the strains which were most successful at Bremersdorp did well at Ingwavuma also. The strains which were most generally successful under this season's conditions were 9243, 920 and 9312 while 9241, 9274 and 9331 were disappointing.

Through the kind co-operation of farmers, some twelve of the strains which appeared in the Variety Trials were planted as observation plots in different areas. These received even less rain than the plots on the Stations and it is noteworthy that these observation plots tended to corroborate the results of the Trials. It was unfortunate that no district received sufficient rainfall to test the behaviour of the strains under rather wetter conditions.

As has been mentioned earlier in this report, jassid was negligible in the bulk cotton fields, but a slight infestation took place on the Bremersdorp Station due to the presence of trap crop cotton. Jassid spread from this, but the attack was too light to be of value in testing the various strains.

Bulk observation plots of some of the older U.4 selections were planted at the two Stations, and also under irrigation. Bollworm was heavy on the irrigated plots and the yields suffered. The yields are given in Table II.

TABLE II.

Strain.	*Bremersdorp.* *Yield, lbs. seed cotton per acre.*	*Ingwavuma.* *Yield, lbs. seed cotton per acre.*	*Irrigated.* *Yield, lbs. seed cotton per acre.*
C.39	1,010	696	576
4/4/10	810	676	526
4/2	776	584	598
4/4	769	552	642
H.77	732	572	562
894	716	528	476
Z.9	690	538	618
Z.14	680	558	582
C.15	576	760	502

There is a marked resemblance in the behaviour of certain of the strains under all conditions, though the high bollworm attack on the irrigated plots tended to level up the various strains in that series. C.39 did well at all places and this was borne out by its good performance under actual farm conditions.

Spacing Experiment.—Experiments were carried out at both stations to test the effect of various spacings on two strains of U.4. The strains used were U.4/4/2—a fairly small early type—and H.77 which is a larger and late type. The plot arrangement was that of randomized

blocks with 6 replications and each plot consisted of 6 rows of each of the two varieties. Four rows per strain plot were weighed, the extra two being guard rows. Results are tabulated below.

TABLE III.

(*a*) BREMERSDORP :

Spacing.	U.4/4/2.		H.77.	
	Seed cotton in lbs. per acre.	*Difference from Mean.*	*Seed cotton in lbs. per acre.*	*Difference from Mean.*
9 inches	1,370	+176	1,230	+147
12 inches	1,250	+ 56	1,065	— 18
18 inches	1,126	— 68	1,080	— 3
18 inches	1,028	—166	955	—128
Mean	1,194		1,083	

Standard Error of difference between two spacings { U.4/4/2 ... 74·0 / H.77 ... 59·2

Difference required for significance (P=·05) ... { U.4/4/2 ... 161·5 / H.77 ... 129·0

(*b*) INGWAVUMA :

Spacing.	U.4/4/2.		H.77.	
	Seed cotton in lbs. per acre.	*Difference from Mean.*	*Seed cotton in lbs. per acre.*	*Difference from Mean.*
9 inches	695	— 78	705	— 29
12 inches	802	+ 29	755	+ 21
18 inches	730	— 43	710	— 24
24 inches	818	+ 45	723	— 11
30 inches	818	+ 45	775	+ 41
Mean	773		734	

Standard Error of difference between two spacings { U.4/4/2 ... 71·5 / H.77 ... 54·7

Difference required for significance (P=·05) ... { U.4/4/2 ... 149·0 / H.77 ... 114·0

In the experiment at Bremersdorp one of the blocks had its stands considerably reduced by an attack of cutworm and could not be used. In addition, a further plot of the widest spacing—30 inches—was also badly attacked and the results for Bremersdorp have been worked out on 5 blocks of 4 spacings. With both strains, the general trend of yields was in order of plant density, while at Ingwavuma there was no significant differences between any of the treatments. It will be seen that at both stations the early U.4/4/2 yielded higher than H.77 at all spacings. Under conditions of higher rainfall the latter would probably be more successful.

Height of Thinning.—A thinning experiment was carried out at both stations in randomized blocks with four replicates, and the thinning operations were done at each stage, under climatic conditions

as alike as possible. At Bremersdorp the experiment was duplicated, one set of plots being thinned to a spacing of 2 feet and the other to 1 foot.

TABLE IV.

Height of Thinning (Approximate).	*Bremersdorp.*				*Ingwavuma.*	
	1 foot spacing.		*2 feet spacing.*		*2 feet spacing.*	
	Seed cotton lbs. per acre.	*Difference from Mean.*	*Seed cotton lbs. per acre.*	*Difference from Mean.*	*Seed cotton lbs. per acre.*	*Difference from Mean.*
6 inches ...	910	+112	664	+207	628	+ 57
9 inches ...	783	— 15	437	— 20	640	+ 69
15 inches ...	702	— 96	270	—187	446	—125
Mean	798		457		571	

Standard Error of difference between two treatments — Bremersdorp 1 foot ... 73·0; Bremersdorp 2 feet ... 44·7; Ingwavuma 2 feet ... 70·8

Difference required for significance (P=·05) ... — Bremersdorp 1 foot ... 179·0; Bremersdorp 2 feet ... 109·0; Ingwavuma 2 feet ... 174·0

The results under this season's conditions are very striking, as in all cases, except for the first thinning at Ingwavuma, the yields dropped with each successive thinning. The comparative failure of the first thinning at Ingwavuma can be readily understood as it encountered a three weeks' drought just after thinning was completed. It will be seen from the Bremersdorp results that the depression of yield due to delayed thinning is much less when the plants are left in a closer spacing, and in areas where thinning is delayed for any reason the practice of close spacing should be of value.

Check-Row Planting.—An experiment was carried out at Bremersdorp to test the suitability of planting cotton in check rows and so facilitating after-cultivation. The seed was planted 3 feet apart in 3-feet rows and the experiment included a series of plots in which one plant, two plants and three plants per hole were left. The arrangement was that of randomized blocks with six replicates. U. bulk seed was used.

TABLE V.

No. of plants per hole.	*Yield per acre seed cotton. lbs.*	*Difference from Mean.*
1 plant	912	—29
2 plants	902	—39
3 plants	1,008	+67
Mean	941	

Standard Error of difference between two treatments ... 54·0

Difference required for significance (P=·05) ... ... 121·0

The plots with 3 plants per hole gave a higher yield, but the difference is not significant. It was not possible to include plots of the standard spacing of $3\frac{1}{2}$ feet $\times$ 2 feet for statistical comparison, but as the yields of adjoining plots of the same bulk (U.4) planted at the standard spacing varied from 995 lbs. to 750 lbs. per acre, it would appear that no diminution of yield was suffered by planting 3 feet $\times$ 3 feet.

Practically all after-cultivation was done by oxen both down and across the rows. The consequent saving in the amount of hand labour required added to the ease of thinning is of great advantage. Under this season's conditions the plants showed no tendency to sprawl where more than one plant per hole was left. It is intended to repeat the experiment this coming season with the view of obtaining a more precise comparison with the standard practice.

Fertiliser Experiment.—In an experiment at Ingwavuma no significant differences in yield were obtained between fertilised and unfertilised plots. During the season there were no observable differences in growth or earliness.

Rotation Crops.

From the point of view of crops other than cotton the season was very unfavourable and the only crop to stand up to any extent to the trying conditions was groundnuts. The rotation crops are planted after the cotton—this year in late December and early January —and the prolonged dry conditions resulted in poor growth and low yields.

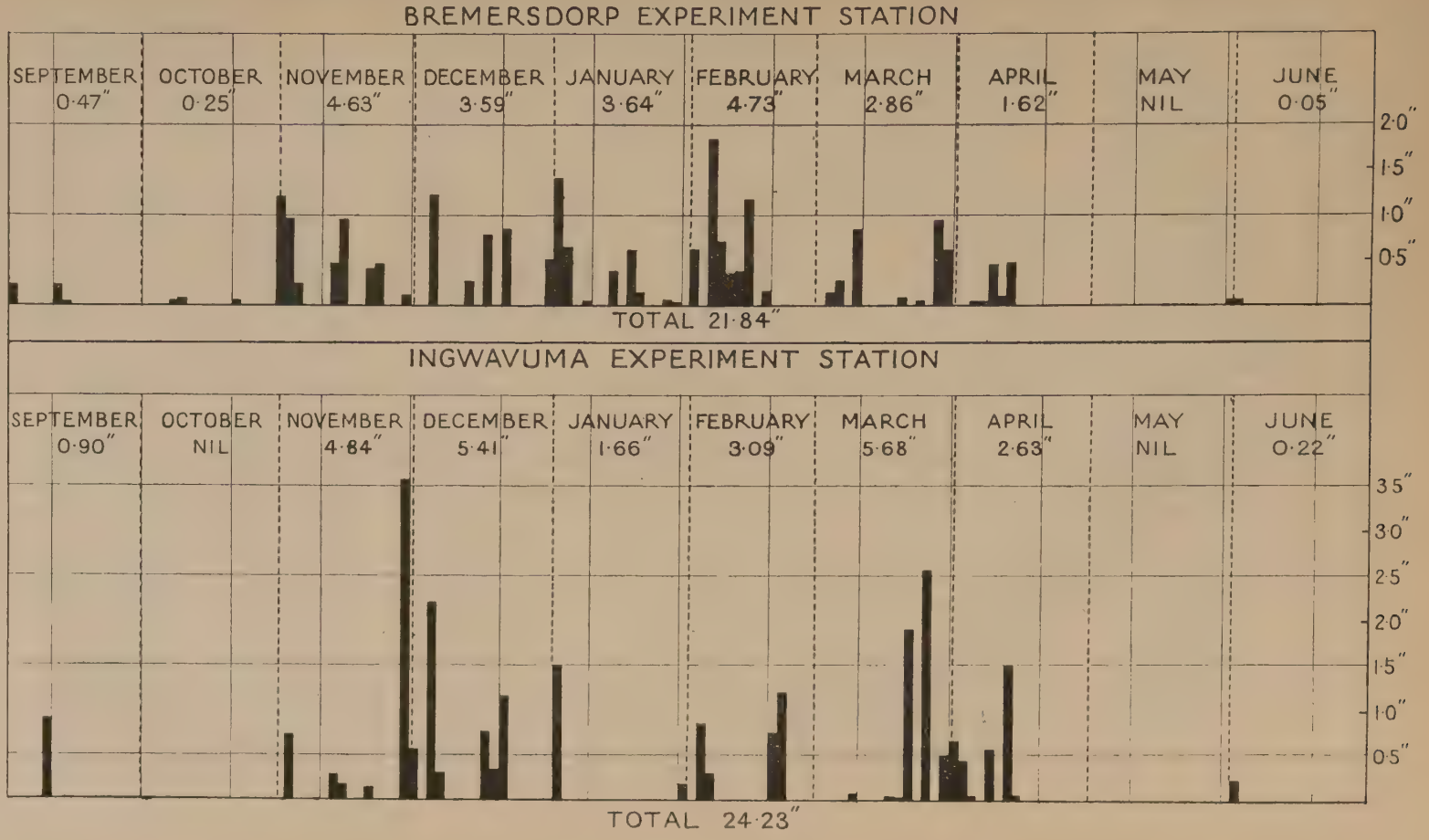
Cereals.—A range of varieties of *Sorghum vulgare* and Bulrush millets were grown at both stations. At Ingwavuma several of the varieties of Kaffir corn stood up to the trying conditions sufficiently well to warrant their being persevered with, particularly as the conditions in that area are unsuitable for maize. On the Bremersdorp station the only cereals to show any promise were maize and an early maturing bulrush millet.

Groundnuts.—Tests of several varieties of groundnuts at both stations showed the Japanese and Spanish Bunch to be practically identical in yield and both superior to Virginia Bunch. The latter, as in the previous year, did not fill out well in the low rainfall conditions, but gave satisfactory yields of good kernels when irrigated. As mentioned above groundnuts were the most successful rotation crop this season, giving yields of from 1,000 lbs. per acre at Bremersdorp to 1,400 lbs. at Ingwavuma.

Beans.—The bulk plantings at Bremersdorp consisted of speckled sugar beans, one half of the area planted early in January and the other three weeks later. Yields were low, the first planting giving 350 lbs. per acre and the second 275 lbs. Of the other beans which were grown in observation plots the most successful was the Tepary bean which yielded up to 700 lbs. per acre. A variety of Soya bean—Southern—was promising in a close spacing, but a bush type of Lima bean was a failure at both stations owing to drought and to the attack of C.M.R. beetle.

Observation plots of various rotation crops were planted on the land placed at our disposal by Cotton Plantations Ltd., at Nsoko. In addition to the rainfall, the plots received two waterings and the yields were considerably higher than on the dry land plots on the two stations, and it is felt that still higher yields could be obtained by additional watering. Of the crops grown, maize, groundnuts and Soya beans responded well to irrigation.

RAINFALL (IN TWO DAY TOTALS) SWAZILAND - SEASON 1930-1931.



SOUTHERN RHODESIA

REPORT ON THE WORK OF THE COTTON-BREEDING STATION, GATOOMA, FOR THE SEASON 1930-31.

INTRODUCTORY NOTE BY G. S. CAMERON.

The accompanying report covers another year's activities on the Cotton Breeding Station at Gatooma, where the accumulated experience of several years' work is beginning to bear fruit in various directions. Precise details of the work involved are summed up in a series of tables which are illustrated by graphs, and fully discussed in the text of the report.

The report mentions the severity of the Sudan bollworm attack in comparison with that of American bollworm—a new phase in the insect problems which beset the industry. While not minimising the potential danger of Sudan bollworm, which has always been anticipated, the report indicates that losses from this cause are not likely to be so great as the loss caused by American bollworm. The protracted drought periods in February and March did more to reduce crop yields than did the attacks of the various bollworms. It is interesting to note that jassid attack was mild in comparison with previous seasons.

Despite the severity of the season, it has been possible to collect evidence which confirms advice given in the past in matters relating to cultural practices and the use of artificial fertilisers. It has also assisted in the process of eliminating observation bulks, and strains which can now be discarded, and thus allow greater attention to be devoted to a more restricted group of families and their future derivatives.

The policy of extending the work of the Cotton Breeding Station by means of native recorders, on recording sub-stations on farms in various districts, has more than justified the effort, but it has to be stressed that it is impossible to continue this policy with the existing funds available without seriously curtailing the cultural operations on the main Cotton Breeding Station at Gatooma. The operating costs of the Cotton Station have been reduced to a minimum. Any further reduction of funds will seriously cramp the activities of the Staff. The attempt made, even in a small way, to breed grain moths had to be abandoned for lack of proper facilities. This reference to financial

stringency is not to be taken in any way as a reflection on the generosity of the Government of Southern Rhodesia, which has continued, as in the past, to co-operate to the fullest possible extent in the work of the Corporation in this country. On the contrary, the Government, in addition to financing the work of the Cotton Breeding Station, is providing increased laboratory facilities which will enable the Staff to work under better conditions than had hitherto existed in the temporary buildings which had outlived their period of usefulness.

Although it does not come within the scope of a report on the work of the Cotton Breeding Station, it may not be out of place to mention that many farmers are continuing with cotton-growing despite the fact that present-day prices barely cover the cost of production. It would be unfair, therefore, to judge the future possibilities of cotton-growing in this country on conditions existing at present. It only requires a moderate increase in price to give the necessary fillip to the industry. The low prices received for all agricultural produce has, very naturally, acted as a stimulus to the practice of ratooning, and it is anticipated that there will be a considerable area of ratooned cotton this approaching season.

It is satisfactory to record a distinct improvement in the quality of the Rhodesian cotton over that of previous years, and that the classifying, ginning, and general handling of the crop by the Co-operative Ginneries has been favourably commented on by the Government Cotton Grader in Durban, as well as by the Manager of the Central Co-operative Cotton Exchange, Limited.

COTTON-BREEDING STATION, GATOOMA; REPORT FOR THE SEASON 1930-31.

BY

J. E. PEAT.

The following report represents the combined work of the staff of the Station, Mr. A. H. McKinstry, Mr. A. N. Prentice, and the writer, Mr. A. H. Rattray, the Farm Foreman, and Mr. J. Trinder, who again was responsible for the greater part of the routine recording and the graphing.

SUMMARY.

It is necessary in reviewing the season to consider the results in the main cotton-growing areas of the country as well as on the Station and in its vicinity. Around the Station the season was poor, mainly

due to a severe drought lasting, to all intents and purposes, fifty-one days. In some areas the season was quite good, resulting in satisfactory average yields of good quality: in other districts, as a result of a drought period not so severe as around Gatooma, the season might be described as fair.

Top crops were made after the rains at the end of March, but generally they did not come to much. It is suggested that the higher, March/April, minimum temperatures might account for the distinctly better quality of most of the Rhodesian lint this year, in spite of the difficulties of the season.

On the Station the bollworm attack was but moderately bad. There was a short, fairly severe attack of American bollworm which stopped suddenly in the middle of March. A fairly severe Sudan bollworm attack continued through the season: it threatened to be serious, but did not do the amount of damage that was anticipated. Undoubtedly this year on the Station more serious loss was caused by the drought—the physiological shedding, and the stunting of the plants, as a result of the drought—than by the bollworm attack.

In other districts, on the whole, bollworm attack seemed to have been more moderate than last year. Only in a few instances were crops practically wiped out. Moderate attacks of American, Sudan, and Spiny bollworms were common but, other factors being favourable, crops were still left which would have been considered satisfactory had prices been better.

Bollworm eggs were collected on the Station and on the four farms, in Mazoe, Lomagundi, and near Bulawayo, on which native recorders were stationed. They were bred out to study the degree of natural parasitism. No benefits were apparent from the small liberations, which were possible on the Station, of *Trichogramma lutea*. The results from a dusting, at the end of February, of the Station crop with calcium arsenate were inconclusive.

Jassid attack was negligible, possibly as a result of the drought; even the most susceptible strain suffered little from attack.

On the Station the substrain trials of four of the better Gatooma lots with U.4 Mixed Bulk, and Parnell's U.4/4, gave results of little significance, but it has been possible, as a result of a difficult season, to discard much of the more doubtful material in the single-plant lots. A smaller number of re-selections have been made, but sixty-eight primary single-plant lots are being re-grown this coming season: seventy-five per cent. of these are derivatives from four families, /26, /64, /78, and /106. There is some excellent material amongst them.

/64, possibly the best Gatooma U.4 stock, was issued to a number of growers throughout the country last year for seed plots. It did well.

Most of the commercial cotton of the country was planted at a closer spacing in the row than formerly. The closer spacing adopted must have played an important part in the satisfactory yields which were obtained in spite of drought and bollworm attack. General observations and the results of the trials bear this out.

As regards fertilisers, there is no reason to change the views expressed last season. There appears to be little benefit to cotton, in the types of season experienced, from the surface application of fertiliser at the time of planting. The second year effect is being studied. On certain soils good results were obtained with cotton after a green manure crop.

A start has been made with extension work from the Station, by collecting records from several districts. The necessity for getting more information about the seasonal development, insect attack, the responses to cultural practices, and the behaviour of the better substrain types in these other areas has been stressed.

Season.

Considering the crop from an agricultural point of view only, 1930–31 has been a season which, for some of the cotton-growing areas of Southern Rhodesia, has been fairly good, and for others fair, although in the Gatooma district and on the Station itself crops have been relatively poor. In general it has been a season where the length of the drought periods in February and March definitely had more to do with the failure or success of the crop than had factors such as bollworm or other insect attack. The better yields and quality of the crops in the Mazoe district and in parts of Lomagundi were in general related to the shorter drought periods they experienced.

The conditions of the season have again indicated the importance of not restricting the cotton experimental work of the country to the Station and its immediate vicinity. It appears essential to extend from the Station to other districts a portion of the type of work that is being done, so that the knowledge gained from the reactions to varied growing conditions, may be summed to give a more complete picture for the country: another advantage to be gained is that a partial failure, due to drought or bollworm, in one area such as the Gatooma area, would not represent so big a loss as it may at present. Furthermore, it is important to get some idea over a number of years

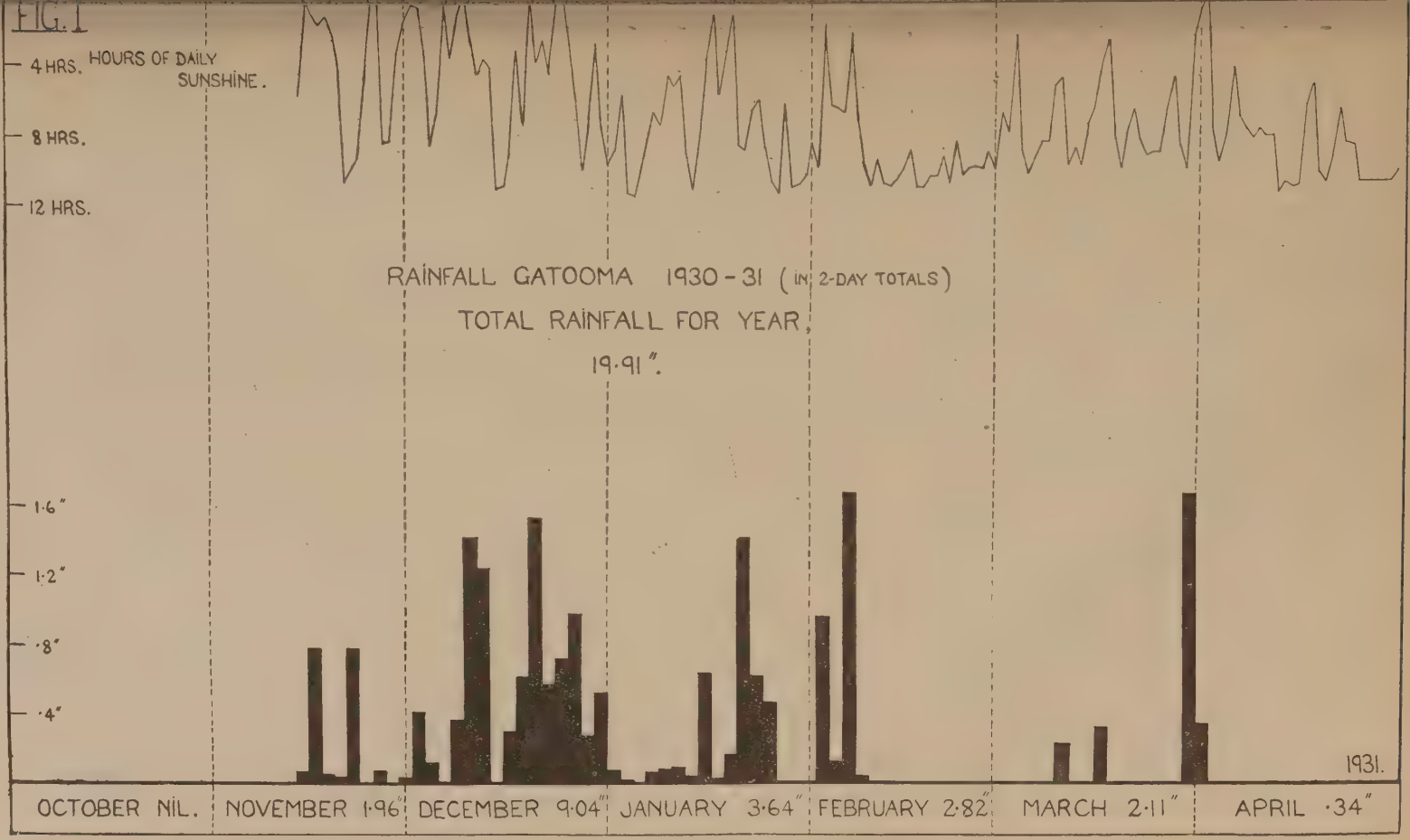
of the actual growing conditions and the environmental factors affecting the crop in other districts, to gain a fuller understanding of the usefulness of cultural practices found suitable on the Station, *e.g.*, fertilising, spacing, insect control measures, and, probably most important of all, to collect data as to the behaviour of the better substrain types as regards their yielding power and quality, in these other areas under varying climatic and environmental conditions, differing, over a period of years, from the conditions on the Station at which they were selected and multiplied.

A beginning has been made with this type of extension work. It is sincerely hoped that, in spite of the economic difficulties of the present time, it may be possible to develop this very necessary side of the work, with the minimum of expenditure.

On the Station the season has been fairly difficult. Conditions were very favourable until early February (Fig. 1). Planting rains were quite good, and December and January were good growing months. But, from the end of the first week in February, until the end of March there was no useful rain : there was a drought, to all intents and purposes, of fifty-one days, at a critical time in the growth and development of the young plant. The drought started right at the beginning of the flowering period, with small plants just developing a root system. Had the rains continued a week or two longer, the effect of a drought of equal length would probably not have been so serious : a better root system would have been developed. As was to be expected with a drought at this period of the year, temperatures were high : the days were hot, with strong sun. Growth was soon checked, and then ceased. (*See* Fig. 4.) The framework of the plant, especially when grown at commercial spacings, was thus very seriously stunted and was incapable of carrying even a fair commercial crop. Flowering was checked and then practically stopped, and there was a sharp rise in natural bud and young boll shedding.

The rains at the end of March started growth recovery in mid-April, most easily in the multiplication bulks and the single-plant lots on the better land and at a wide spacing : this was followed later by a recovery in flowering in May, but too late for a satisfactory second crop. The plants at the wide spacing in the multiplication plots, and the single plant lots with their better powers of recovery flowered and fruited fairly freely, but carried through only a moderate second crop, poorer in quality than the first. The plants at the commercial spacings found it much more difficult to recover, and to restart growth and flowering. For the season, however, the moderately close spacings gave the heaviest total crop.

FIG. 1


4 HRS.
HOURS OF DAILY SUNSHINE.
8 HRS.
12 HRS.
RAINFALL GATOOMA 1930-31 (IN 2-DAY TOTALS)
TOTAL RAINFALL FOR YEAR, 19·91".
1·6"
1·2"
·8"
·4"
1931.
OCTOBER NIL.
NOVEMBER 1·96"
DECEMBER 9·04"
JANUARY 3·64"
FEBRUARY 2·82"
MARCH 2·11"
APRIL ·34"

One small area of plants at close spacing on fairly shallow soil were growing after sunn hemp cut for seed the previous year. There was thus, probably, a fair nitrogenous residue from the sunn hemp root nodules. The early growth was too quick and sappy. The plants of this area received a more severe check from the drought than the plants which had made steadier growth. There was a quick stoppage of flowering with a heavy shedding of buds and young bolls, followed later by bad boll-opening. These plants were quite unable to respond to the late rains and they produced distinctly softer, poorer quality lint than the bulk of the crop, stunted as it was. A portion of the crop planted after sunn hemp ploughed in suffered from the drought least of all the cotton on the Station. It made growth even during the drought and came away well after the late rains. Probably this was due to the better moisture-retaining power of the soil as a result of the added humus.

When touring, crops were noticed that had probably grown out too sappily before the drought started, and had consequently suffered more from shedding than plants with a smaller growth. Under drought conditions, one associated more bad boll-opening with this type of crop than in more compactly grown crops, under similar conditions. It is probably fair to attribute much of this type of bad opening to weakness caused by prolonged drought effect on an oversappy plant.

The rainfall and temperature graphs for Mazoe (Fig. 3), show that areas there experienced quite a fair season climatically. The February/March drought was shorter and did not cause the severe check to the development of the plant that was experienced in the Gatooma area.

In parts of Lomagundi the drought was also less severe and followed a period of very good rains, which must have meant a fair reserve of soil moisture.

The temperatures, especially the minimum temperatures, of the later end of the growing season, March, April and May, were distinctly higher than last year (Fig. 2), and it seems reasonable to suggest that these more favourable temperatures during the development of the bolls were largely responsible for the better strength and quality of most of the Rhodesian lint as compared with that of last year, even in spite of the severe drought experienced by many of the crops.

Reference has been made in past reports to the long development period of the later bolls formed. Last season, 1929–30, for example, marked bolls from flowers tagged towards the end of April and in May, were taking from 85–95 days from flowering to boll-opening. This past season results have been very different: it is difficult to suggest a reasonable explanation.

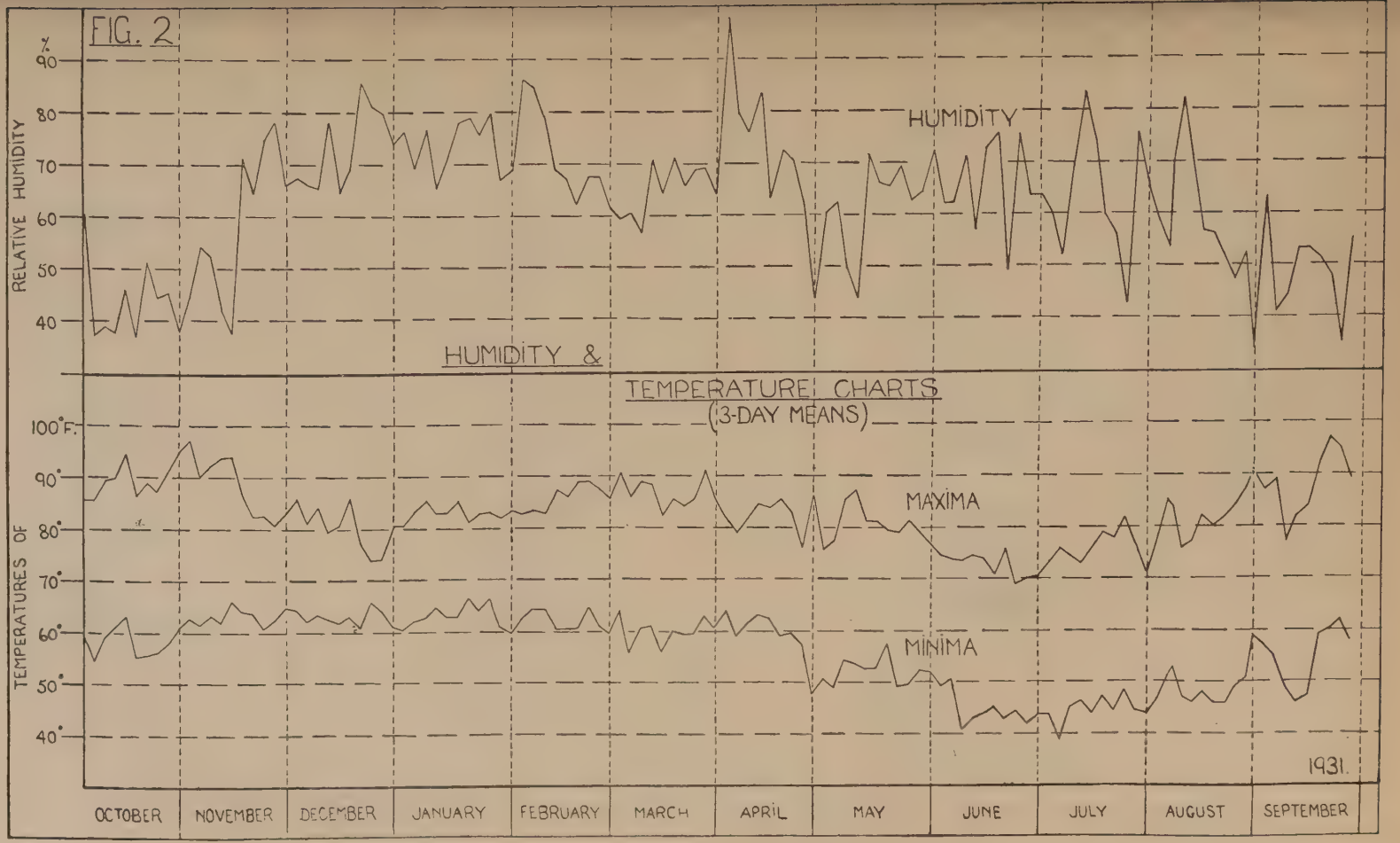


FIG. 2
RELATIVE HUMIDITY
%
90
80
70
60
50
40
HUMIDITY
HUMIDITY &
TEMPERATURE CHARTS
(3-DAY MEANS)
TEMPERATURES OF
100°F.
90°
80°
70°
60°
50°
40°
MAXIMA
MINIMA
1931.
OCTOBER
NOVEMBER
DECEMBER
JANUARY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER

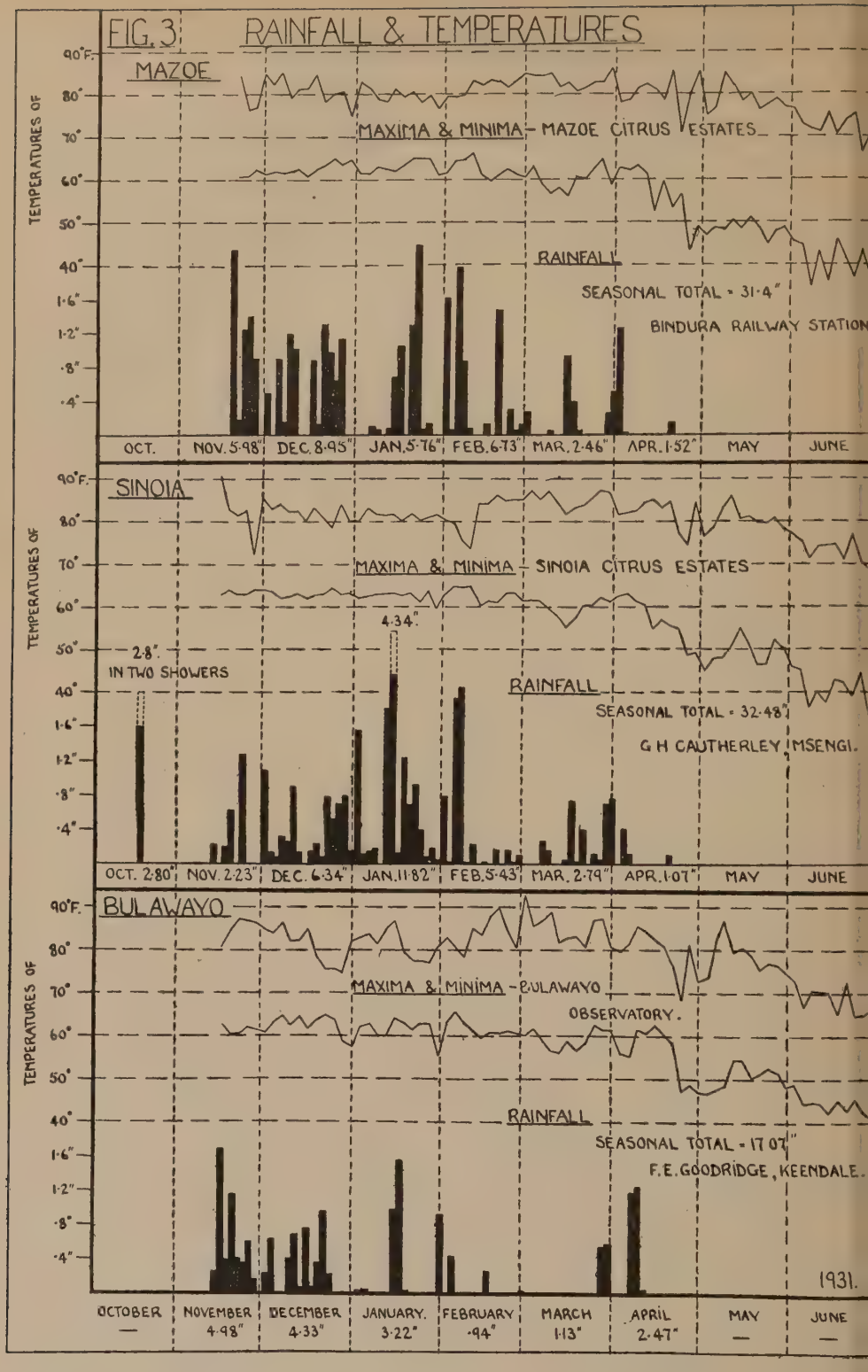


FIG. 3 RAINFALL & TEMPERATURES
MAZOE
MAXIMA & MINIMA - MAZOE CITRUS ESTATES
RAINFALL
SEASONAL TOTAL - 31·4"
BINDURA RAILWAY STATION
SINOIA
MAXIMA & MINIMA - SINOIA CITRUS ESTATES
2·8" IN TWO SHOWERS
4·34"
RAINFALL
SEASONAL TOTAL - 32·48"
G H CAUTHERLEY, MSENGI.
BULAWAYO
MAXIMA & MINIMA - BULAWAYO OBSERVATORY.
RAINFALL
SEASONAL TOTAL - 17·07"
F.E. GOODRIDGE, KEENDALE.
1931.
TEMPERATURES OF
90°F.
80°
70°
60°
50°
40°
1·6"
1·2"
·8"
·4"
OCT. NOV. 5·98" DEC. 8·95" JAN. 5·76" FEB. 6·73" MAR. 2·46" APR. 1·52" MAY JUNE
OCT. 2·80" NOV. 2·23" DEC. 6·34" JAN. 11·82" FEB. 5·43" MAR. 2·79" APR. 1·07" MAY JUNE
OCTOBER — NOVEMBER 4·98" DECEMBER 4·33" JANUARY. 3·22" FEBRUARY ·94" MARCH 1·13" APRIL 2·47" MAY — JUNE —

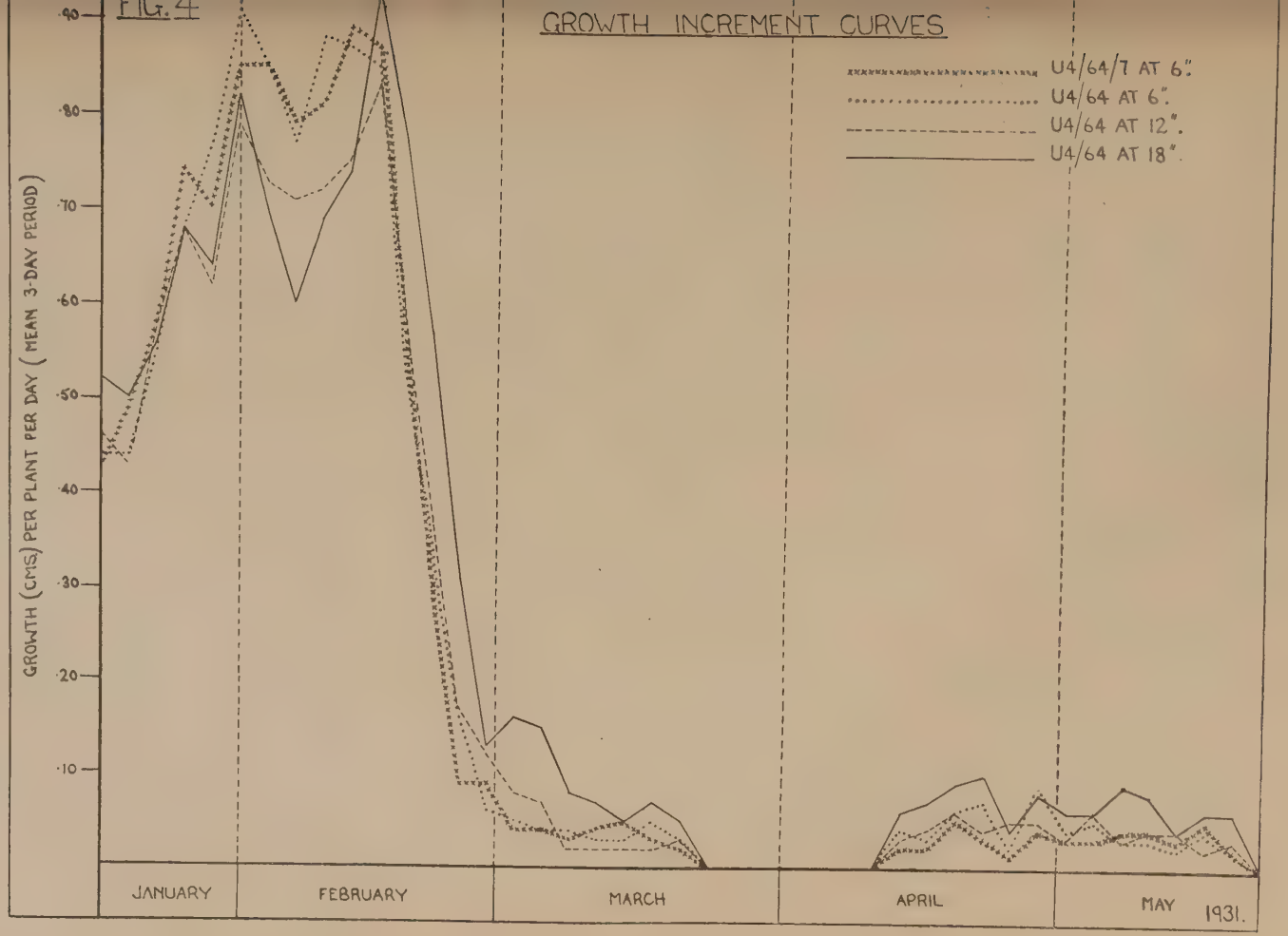


FIG. 4
GROWTH INCREMENT CURVES
U4/64/7 AT 6".
U4/64 AT 6".
U4/64 AT 12".
U4/64 AT 18".
GROWTH (CMS.) PER PLANT PER DAY (MEAN 3-DAY PERIOD)
·40
·30
·20
·10
JANUARY
FEBRUARY
MARCH
APRIL
MAY
1931.

TABLE I.

Boll Maturation Period.

Date of Flowering.	*No. of Flowers Tagged.*	*No. of Bolls Matured.*		*Mean Maturation Period.*	*Range.*
		Actual.	*Percentage.*		
11.4.31	80	37	46%	68 days	61–84 days
20.4.31	80	39	49%	65 days	56–78 days
4.5.31	80	26	33%	56 days	50–64 days
11.5.31	80	28	35%	55 days	47–67 days
16.5.31	80	15	21%	57 days	47–64 days
25.5.31	80	13	16%	50 days	44–58 days
1.6.31	80	12	15%	55 days	51–58 days
9.6.31	80	10	13%	46 days	42–50 days
15.6.31	80	17	21%	40 days	37–45 days

Table I shows the maturation figures for flowers tagged from the 11th April until the 15th June. The tagging was undertaken primarily to observe after what date for the season flowering was ineffective. It will be seen that bolls were opening in May which had taken around fifty-five days to develop, and in June from forty to fifty days. They were producing lint of fair quality and moderate strength. The records were taken from multiplications of /64/7 and /78/3, on land which had had a green manure crop ploughed in the previous year. The stand was not good. There was thus a greater retention of the top-crop than in the trial plots, which were at commercial spacings.

Insect Attack.

Bollworms.—Speaking generally, this past season the loss due to insect attack was secondary to the loss of potential crop caused by the drought. On the Station, during the period from February to April, three-quarters of the flowers made did not mature into bolls: they were shed or aborted, and of these slightly less than one-half exhibited bollworm punctures (Fig. 7 and Table V). This, plus the damage to a portion of bolls which matured, represents the bollworm damage.

On the Station, one of the most interesting features of the year has been the heaviness of the Sudan bollworm attack relative to that of American bollworm, and contrasted with the attacks of previous years. It is the first year on the Station that Sudan bollworm has been a major pest on the annual cotton. While serious and disturbing in the damage that it may cause especially to the older bolls, it would

seem that Sudan bollworm is not to be feared as much as American. Proportionately it does not do as much damage. It does not appear to move about so much in feeding, and the bigger Sudan bollworms feed rather within the bigger bolls, instead of demolishing squares and the younger bolls. One can imagine a moderately heavy and protracted Sudan bollworm attack, and yet, other conditions being favourable, quite a good commercial crop being reaped, while, with an attack of American bollworm of the same extent and duration, there would be practically no crop to reap.

The bollworm population started to increase about the middle of February (Fig. 5). All three species, American, Sudan, and Spiny, were present in approximately equal numbers and the attack quickly rose to a peak early in March. It looked as though a heavy loss would be experienced again from American, with a secondary loss from Sudan and Spiny. But there was an equally sharp drop, and the American attack had practically ceased by the middle of March. On the Station there appears to have been only the one brood of American bollworm, mid-February to mid-March. The outside records from a farm near Bulawayo in Matabeleland, and from two farms in Mazoe Valley near Bindura, also show the one brood of American, starting in March and finishing in early April, while the Sudan bollworm attack continued steadily into June. At the farm in Lomagundi on which records were taken the American attack was much more severe, and there were more broods than one.

Sudan and Spiny bollworms, probably with several broods, continued throughout the season. Moderate damage was done by the one brood of American, but this was only marked because so little recovery was possible from the stunted plants. There was a fairly heavy loss from the steady Sudan attack, especially in the formed bolls, but even with bolls which had been attacked one, two, or three locks often opened. The opening of the bolls on plants badly attacked by Sudan bollworm was bad. The damage done by Spiny bollworm was much heavier in February/March than has previously been observed on the Station, but the steady minor attack later in the season was similar to that of other years.

In other parts of the country attacks of American, Sudan and Spiny bollworms seem to have varied from light to moderately heavy : but only here and there did one hear of crops being very severely attacked, or completely wiped out, as happened last season.

Ratoons.—Again a small plot of about three-fifths of an acre was cut back as a ratoon-trap observation crop. During the first part of November the plants were clean, but by the end of November, though

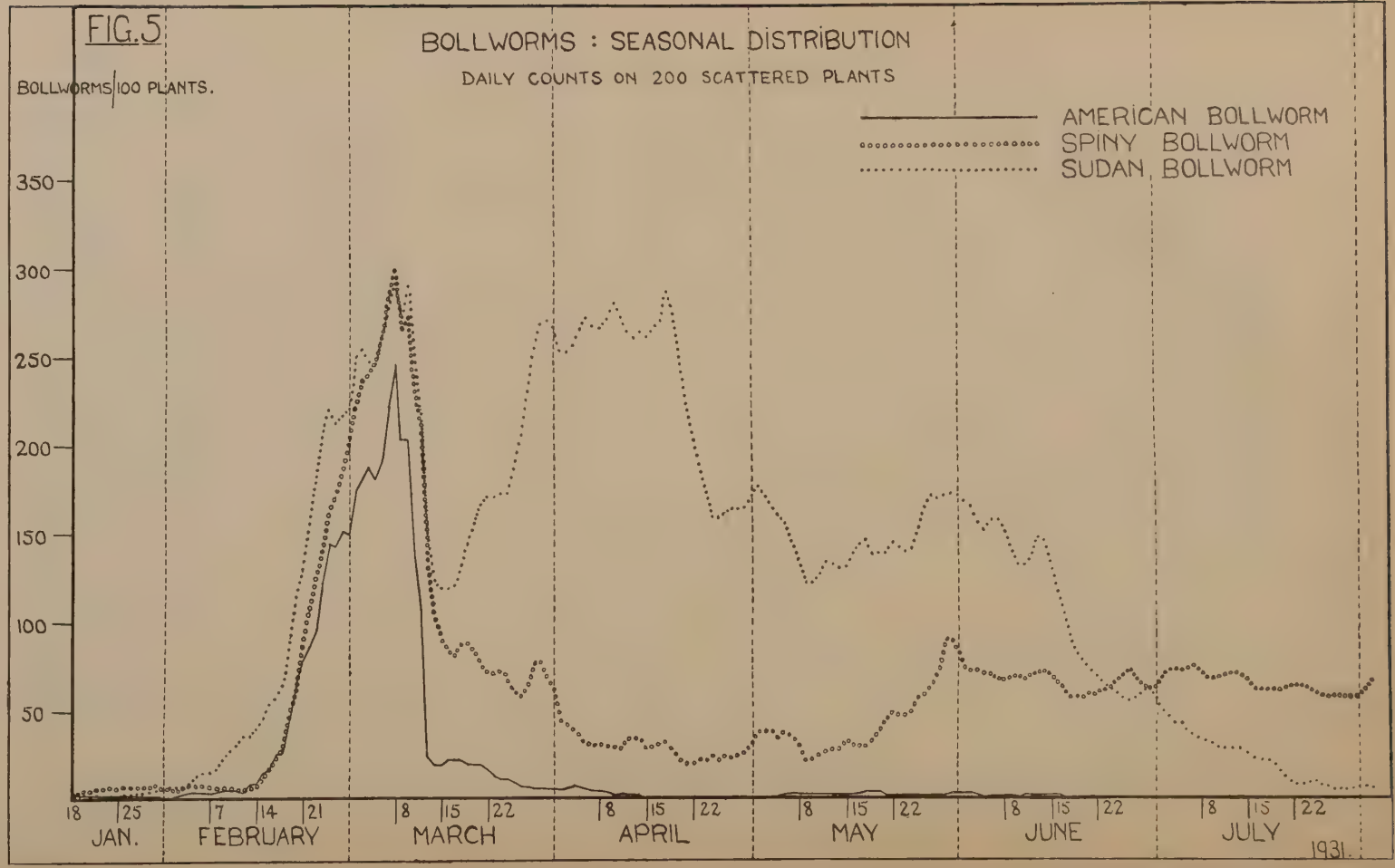


FIG.5
BOLLWORMS : SEASONAL DISTRIBUTION
DAILY COUNTS ON 200 SCATTERED PLANTS
BOLLWORMS/100 PLANTS.
350
300
250
200
150
100
50
AMERICAN BOLLWORM
SPINY BOLLWORM
SUDAN BOLLWORM
18
25
7
14
21
8
15
22
8
15
22
8
15
22
8
15
22
8
15
22
JAN.
FEBRUARY
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the growth was small, Sudan bollworm eggs were plentiful, as many as six to a plant. Eggs were collected but no egg parasites emerged. On standover cotton on a neighbouring farm Sudan bollworm eggs were also collected at this time.

Counts were made on groups of plants on December 11th, which showed an average of 1·75 Sudan bollworms per plant. The mean spacing of the plants was about fifteen inches, which would make a Sudan bollworm population of about fifteen thousand to the acre. The plants were then stripped clean. By the middle of January, examination of the ratoon and the annual cotton showed few Sudan eggs. A count on the ratoons on January 28th showed only an average of one Sudan bollworm to eight plants. The ratoons were then uprooted.

With only the one brood of American bollworm, the maize trap crops were of no service. Until the middle of February practically no American bollworms were found in the field maize. On February 18th large numbers of swallows were to be seen flying low over the maize, probably feeding on egg-laying American bollworm moths. By February 21st young larvae were found hatching on the maize silks. Counts made at the beginning of March showed about one American bollworm to every five maize plants.

A collection of malvaceous plants was started but no eggs or larvae of Sudan bollworms were found on them, although a cotton plant in the garden nearby was spattered with eggs. The malvaceous plants were quite readily attacked by Spiny bollworm.

Dusting.—On February 23rd a start was made to dust with calcium arsenate all the cotton trials, single-plant lots, and multiplications, with the exception of a few control strips. A Niagara duster was used drawn by tractor. Dusting was done in the early morning and from the late evening through a portion of the night. Varying amounts were applied, the average being about 5–7 lbs. per acre. Dusting was finished by February 28th, all having been done under good conditions, but there was no evidence from numerous counts on dusted and undusted strips that the dusting had been effective. It may be, however, that the dusting played a part in the rapid falling-off of the American bollworm population ten days after.

On the farm in Lomagundi on which records were taken there was a bad and prolonged American bollworm attack. A small amount of dusting was done with calcium arsenate using a hand gun. Counts at two-day intervals apparently showed a heavy reduction of larvae in the dusted areas, as compared with these areas before dusting, and with neighbouring undusted areas. The effects of this reduction appeared to be visible at the time of the first picking.

Egg Parasites.—Throughout the season bollworm eggs were collected and bred out to record the extent of parasitism. Each week collections of bollworm eggs were sent in by the native recorders on the farms on which records were being taken; these collections were bred out on the Station.

For about a month, starting from the end of January, cards of grain moth eggs stung by *Trichogramma lutea* were received from Barberton, and the parasites were liberated on the Station. Two tins a week were received, but, owing to breeding difficulties at Barberton, it was found impossible to continue the supply after the end of February—which was unfortunate, since in the season under review that was an important time in the bollworm attack. An attempt was made in a small way to breed grain moths on the Station, and to multiply up *Trichogramma* for experimental liberation, but with the meagre facilities available, it was a complete failure. Even allowing for the small liberations of *Trichogramma* which were possible on the Station in February, the parasite recoveries from the eggs collected were low, definitely lower with the Sudan bollworm eggs than with the American bollworm eggs: on the other hand, a fair percentage of the eggs of a green looper, a leaf eater, were found to be parasitised. In addition to *Trichogramma*, a few black parasites, probably Chalcids, were bred out from the Sudan bollworm eggs.

The collections of eggs sent in from two of the outside record farms, where no liberations had been made, gave much higher percentages of parasitisation than the collections of eggs made on the Station. At Avoca, Bindura, (R. Thornton), the natural population of *Trichogramma* must have played a fair part in keeping down the Sudan and American bollworm population. Towards the end of the season, March and April, there must have been quite a high percentage of natural parasitism.

The results of the liberations of *Trichogramma* on the Station were disappointing, there being negligible recoveries throughout February when the liberations were being made, and the attack developed seriously. It would appear that *Trichogramma* is not a very good parasite for Sudan bollworm eggs, and there are difficulties in its use on a farm scale against American.

Stainers.—Stainers were trapped on the Station, as in past years, starting at the end of March. Trapping was discontinued from May 1st. The majority of the stainers caught were *Dysdercus fasciatus*. The attack was light and late in starting, and catches on the traps were small; but here and there throughout the country, especially where there had been good rains, reports of damage by stainers were received.

A considerable number of farmers, who in past years have experienced loss from stainer attack, have taken up trapping and appear satisfied with the results; and not one of the growers visited this year who had trapped systematically had crops suffering badly from stainer damage. It is very difficult to assess fairly the saving effected on the crop, and it will only be the experience of growers over a number of years that will decide whether trapping is economical or not. At the present time it appears the only practical control method in sight.

Jassid.—On the Station jassid attack was negligible, due probably to the drought conditions. The jassid graph, Fig. 6, shows the extent of the attack for contrast with other years. Even a highly susceptible strain such as Durango came through the season having suffered only to a minor extent in February.

Aphis.—Aphis was quite bad on the Station for about six weeks, from about the end of January until the first week in March. The attack definitely slowed down growth and checked the development of the plants. The attack was patchy, and, where aphis was less plentiful, growth was noticeably better. Aphis had almost disappeared by the third week in March due, possibly, to a change in the metabolism of the plant in the change over from conditions inducing a sappy type to conditions of drought.

U.4 Substrains—Selections and Re-Selections.

On the Station the season was such that effective comparisons between strains, and between single-plant lots, were difficult. As in past years, not one of the other varieties grown gave results as satisfactory as the U.4 lots, and amongst them the behaviour of the older substrains was more or less as expected.

A strain trial (Latin Square), was laid down comparing U.4 Mixed Bulk, /64, /64/7, /78/3, /26/4, and Parnell's U.4/4: the spacing used was six inches in the row. Mean yields were low, about 250 lbs. per acre. Results were compared on the basis of yields of lint per acre, there being quite fair differences in ginning percentage between strains—as much as 4%. The ginning percentages were 2 to 3% lower than last season. Although stands were quite good, it was unfortunate that the mean percentage stands varied amongst the strains under comparison. The Mixed Bulk averaged 67%, and the remainder between 75% and 82%. The low final yields, and the variations in stand between strains, make the results of doubtful significance. /26/4 and 64/7 appear to be the heaviest yielding strains

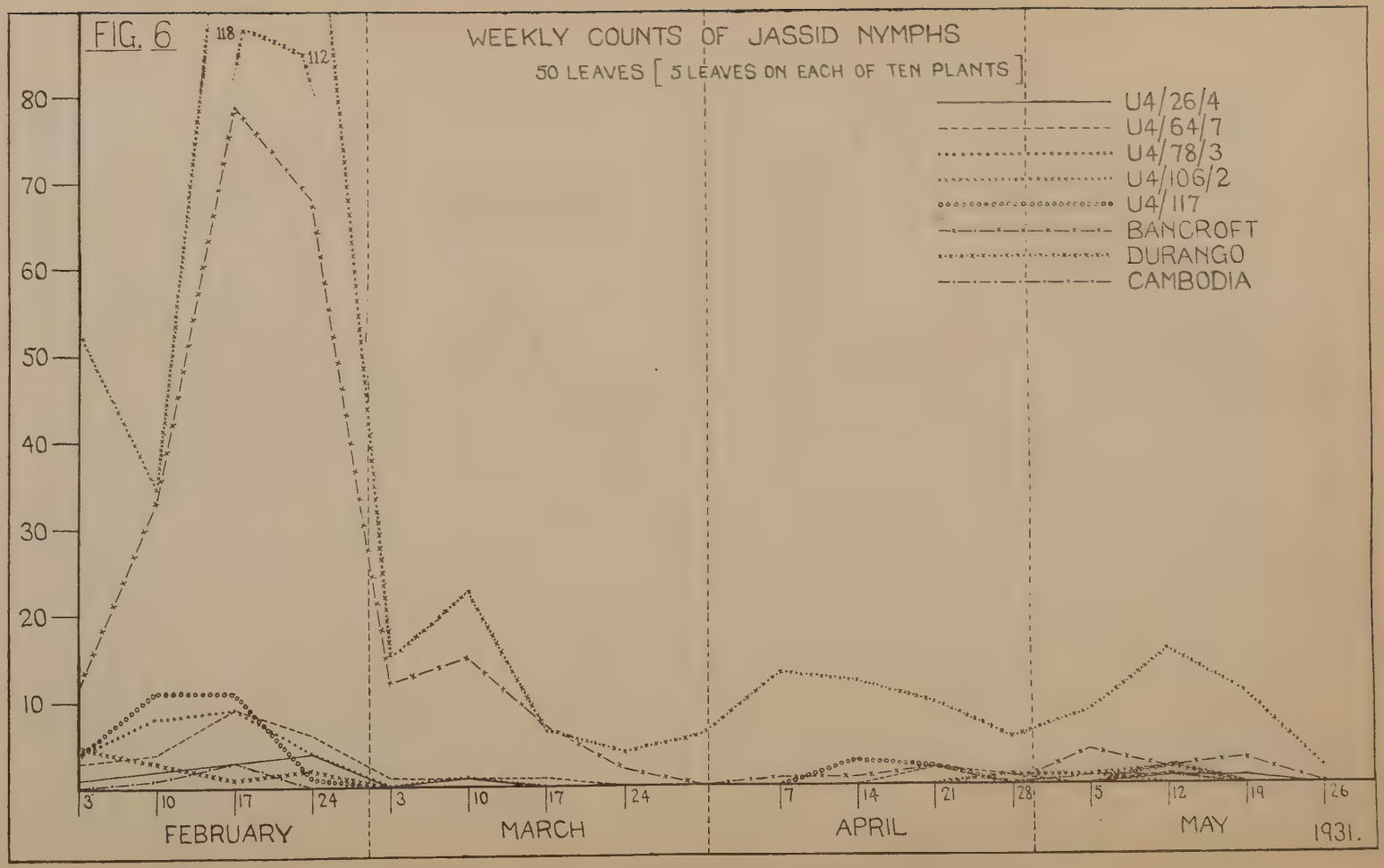
FIG. 6
WEEKLY COUNTS OF JASSID NYMPHS
50 LEAVES [5 LEAVES ON EACH OF TEN PLANTS]
U4/26/4
U4/64/7
U4/78/3
U4/106/2
U4/117
BANCROFT
DURANGO
CAMBODIA
118
112
80
70
60
50
40
30
20
10
3
10
17
24
3
10
17
24
7
14
21
28
5
12
19
26
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and significantly heavier yielding than Mixed Bulk, with /64/7 significantly heavier yielding than /64.

All the seed to be used for trials this coming season has been acid-treated, and only seed which sinks in water will be used. Of seed from the first picking some 80%–85% sinks in water as compared with 60%–65% of the seed from the second and third pickings.

A spacing trial (Latin Square), Fig. 9, was laid down, in which U.4 Mixed Bulk and /64 were compared at the four spacings, 6 inches, 12 inches, 18 inches and 24 inches. Using seed-cotton weights, /64 yielded significantly better at all spacings, but using lint weights, only at two spacings was /64 significantly the heavier yielder. The comparison between the strains, however, is of little value because of the poor yields and the variations in stand : /64 had considerably the higher percentage stand.

Fig. 7 and Table V show the distribution of boll shedding, and the proportions of the shed bolls which exhibited bollworm punctures. An analysis was made of the shedding for each of the strains in the strain trial. The bolls reaped accounted for approximately a quarter of the flowers formed. No differences of any value appeared as a result of contrasting the percentages of sheds for each strain in the trials.

/64 was issued to farmers last season for seed plots, and, when seen growing in Mazoe and Lomagundi under favourable conditions, it had done very well. It is undoubtedly prolific and a very useful strain. It is moderately early and of a semi-open habit, a prolific fruiter, and under difficult conditions it opens well compared with neighbouring lots : it is unfortunate that it should have, for U.4, a relatively low ginning percentage. Apart from this it is probably the premier Gatooma stock. The lint qualities and the spinning results will be referred to later.

The development records at Msengi, in Lomagundi (G. H. Cautherley), from a strain trial of U.4 Mixed Bulk and U.4/64, are graphed in Fig. 8 : they are discussed later. This was one of the few farms in the country which sustained a bad and continued American bollworm attack, starting in February, continuing through until May, and causing considerable loss.

The slightly greater flowering capacity of /64 is brought out, resulting in a heavier crop. The Mixed Bulk produced the heavier top crop, but the bolling curves show how small a fraction of this was set. The yield trials show a significant difference in favour of /64, with the yields measured in lbs. seed cotton. The mean yield per acre for /64 was 406 lbs. as against 344 lbs. per acre for Mixed Bulk. When

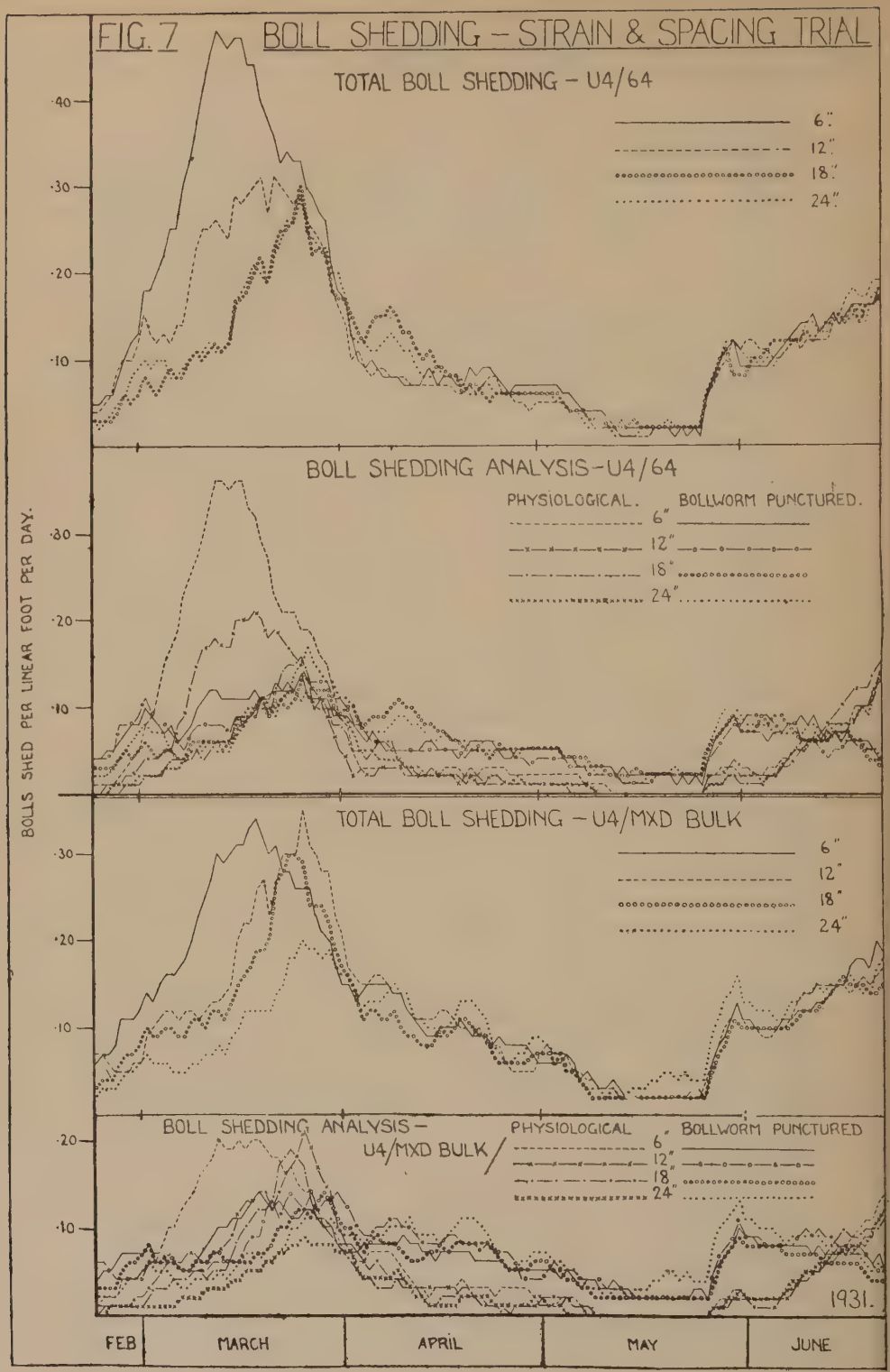
FIG. 7
BOLL SHEDDING – STRAIN & SPACING TRIAL
TOTAL BOLL SHEDDING – U4/64
6"
12"
18"
24"
BOLL SHEDDING ANALYSIS – U4/64
PHYSIOLOGICAL.
BOLLWORM PUNCTURED.
6"
12"
18"
24"
BOLLS SHED PER LINEAR FOOT PER DAY.
TOTAL BOLL SHEDDING – U4/MXD BULK
6"
12"
18"
24"
BOLL SHEDDING ANALYSIS – U4/MXD BULK
PHYSIOLOGICAL
BOLLWORM PUNCTURED
6"
12"
18"
24"
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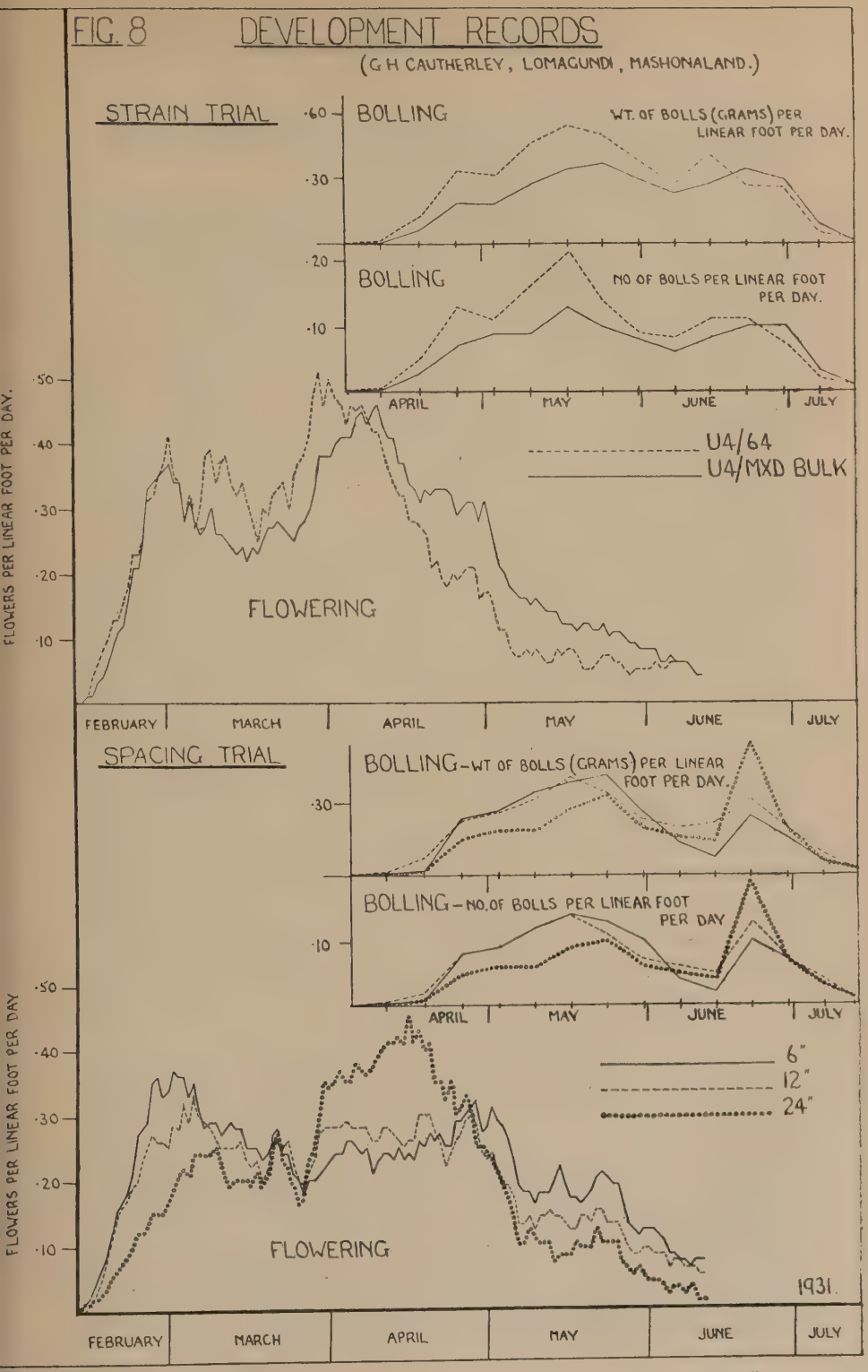


FIG. 8 DEVELOPMENT RECORDS
(G H CAUTHERLEY, LOMAGUNDI, MASHONALAND.)
STRAIN TRIAL
BOLLING
WT. OF BOLLS (GRAMS) PER LINEAR FOOT PER DAY.
·60
·30
BOLLING
NO OF BOLLS PER LINEAR FOOT PER DAY.
·20
·10
APRIL
MAY
JUNE
JULY
U4/64
U4/MXD BULK
FLOWERING
·50
·40
·30
·20
·10
FLOWERS PER LINEAR FOOT PER DAY.
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
SPACING TRIAL
BOLLING - WT OF BOLLS (GRAMS) PER LINEAR FOOT PER DAY.
·30
BOLLING - NO. OF BOLLS PER LINEAR FOOT PER DAY
·10
APRIL
MAY
JUNE
JULY
6"
12"
24"
FLOWERING
·50
·40
·30
·20
·10
FLOWERS PER LINEAR FOOT PER DAY
1931.
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY

examined in terms of lint the difference is not quite significant, /64 having the lower ginning percentage; but the /64 percentage stand was 75%, against 84% stand for Mixed Bulk.

On the Station there were small observation and multiplication bulks of some fourteen U.4 lots. /64/7 was possibly not so satisfactory as last season. It tended to produce long drooping sympodial branches giving rather a spreading habit, and, while flowering prolifically, it tended to shed considerably in the early part of the season. The growth was, in a manner, indeterminate. This under more equable growing conditions would probably be an advantage in the effect on the quality of the lint. Where growing after sunn hemp ploughed in, and therefore probably under conditions more favourable as regards moisture, it did much better and, for the season, yielded well.

/26/4 is one of the earliest of the Gatooma lots: compact, almost semi-cluster in habit, it produces a quick, early crop, opening freely. It was feared that when grown under difficult conditions, the lint was distinctly poorer than many of the other single plant lots, but the spinning test results do not bear this out. /26/4 and 78/3 behaved more or less as expected, and further special bulks have been made. Special bulks were also taken from /106/2 and /106/3, strains of a distinctive habit. Selections taken last year from these strains are showing considerable promise. Again spinning tests appear to show the lint to be of better quality than was formerly supposed.

An observation bulk of Parnell's U.4/4 was grown, but it did not do very well. It grew out fairly satisfactorily but apparently it was not vigorous enough—it was too fine a strain for the difficulties of the season and it did not crop very well. A special bulk of the better cropping plants was taken out, and a number of re-selections were made, amongst them some good-looking plants. Possibly from amongst them, a lot may be found with the U.4/4 qualities, but more suitable for Rhodesia than the parent stock.

It has been possible, as the result of the confirmatory evidence of a difficult season, supporting the results of other years, to discard more than half of the observation bulks which were grown, and as a result of this, to discard most of the single-plant lots and the re-selections from them. It is now most important to have small plots of the better U.4 stocks, and small plots of some of the more distinctive single-plant lots, growing each year in other districts of the country, before coming to conclusions about their relative merits. Arrangements are being made for this coming season, when it is hoped to have a number of plots scattered throughout the country on a range of soils.

Single Plant Lots.

Ninety-one single-plant lots are being carried on this next season, sixty-eight primary and twenty-three secondary lots : only forty-four further re-selections have been made from last year's lots, together with fifteen re-selections from Barberton material. Quite a number of the lots grown in the past season could be discarded, taking into consideration their behaviour in other years, but the primary lots are worth re-growing before making definite decisions about them : they are good-yielding lots, with qualities which might make them worthy of multiplication. The secondary lots, though not so good, have interesting qualities and habits, which make them worth carrying on another year.

Seventy-five per cent. of the primary lots that are being carried on represent selections from four initial families, /26, /64, /78 and /106. /64 is probably the best of the Gatooma stocks and every effort is being made to get a representative range of lots from it. Some of the new selections from the /64 bulk of 1929 promise well. /78/3/5 is a good yielding selection from /78, and there are some distinctive and high-yielding lots from /106.

In addition to B.U.4/4, six Barberton U.4 selections, U.4/2, U.4/4/2, C.15, C.28, Z.9 and Z.14 were grown under observation. The results were disappointing. Under the conditions of the season not one of them was striking in any way. With the exception of U.4/4/2 they grew out quite well, but the final cropping was only moderate. U.4/4/2, though a pretty strain, was definitely too fine for the difficulties of the season, and possessed little power of recovery. U.4/2 was much more vigorous and leafy : it grew and flowered well, but the final crop was not very good. It produced a heavy top crop, little of which matured. A few re-selections were made, and all the lots will be tried this coming season in other districts as well as at Gatooma.

Lint Qualities and Spinning Tests Results.

All single-plant lots and selections are now examined in the first place by hand tests for mean maximum length, regularity and strength ; and then all that are likely to be carried on are examined in greater detail. Careful sampling is done and Baer Diagrams made for each lot or selection. The "Effective Length" and "Percentage Dispersion," as defined by the Shirley Institute, are used as statements of length and regularity. The analyses of the year have again showed the variations in length which may occur within the strain, due to seasonal influences, sufficient to swamp apparent irregularities such as "butterflying" ; and they emphasise the usefulness of a method such

TABLE II.

DERIVATIVES OF U.4/64: MEANS OF SINGLE PLANT LOTS.

Strain.		*Strain Type,* 1930–31 *Season.*	*Ginning Percentage* (500 *Seeds*).	*Lint Index* (500 *Seeds*).	*Seed Weight gms.* (500 *Seeds*).	*Baer Diagram.*		*Lint Quality.*
Station No.	*Family No.*					*Effective Length.*	*Percentage Dispersion.*	
052/3	(64/7/1)	Slightly open /64 type—good top crop	32·8	4·2	8·6	$1\frac{6}{32}''$	23	Fair strength: regular: harsh.
054/3	(64/7/3)	Good response on poor patch of soil	33·4	3·9	7·9	$1\frac{3}{32}''$	24	Fair strength: regular: silky.
058/3	(64/7/7)	Good yielding type—semi-erect ...	33·1	4·3	8·7	$1\frac{6}{32}''$	29	Strong: regular: silky.
0511/3	(64/7/10)	Best yielder of 64/7 family	32·0	4·1	8·8	$1\frac{6}{32}''$	25	Strong: regular: silky.
0526/3	(64/10/3)	Heavy flowerer—shorter internodes than the 64/7 types.	32·8	4·3	8·9	$1\frac{4}{32}''$	21	Strong: rather harsh.
0527/3	(64/10/5)	Heavy flowerer—similar to 64/10/3	32·0	4·5	9·6	$1\frac{7}{32}''$	21	Strong: rather harsh.
0514/2	(64/D)	Prolific—small growing plants on poor land.	30·7	4·0	9·1	$1\frac{6}{32}''$	27	Strong: regular: silky.
0516/2	(64/I)	Free growing /64 type—good yielder	32·4	3·9	8·2	$1\frac{4}{32}''$	31	Strong: regular: silky.
0517/2	(64/K)	Distinctive, squat spreading type ...	29·8	3·8	8·9	$1\frac{7}{32}''$	23	Strong: regular: silky.
0520/2	(64/U)	Small on poor land but good type ...	31·4	4·4	9·6	$1\frac{5}{32}''$	20	Fair strength: regular: rather harsh.
0521/2	(64/V)	Small on poor land but good type ...	31·3	3·9	8·6	$1\frac{8}{32}''$	27	Strong: regular: silky.

TABLE III.

SOME INTERESTING SINGLE PLANT LOTS—MEANS.

Strain.		*Strain Type,* 1930–31 *Season.*	*Ginning Percentage* (500 *Seeds*).	*Lint Index* (500 *Seeds*).	*Seed Weight gms.* (500 *Seeds*).	*Baer Diagram.*		*Lint Quality.*
Station No.	*Family No.*					*Effective Length.*	*Percentage Dispersion.*	
011/3	(11/2/2)	Moderately vigorous; fairly leafy: good late crop.	34·3	5·4	10·3	$1\frac{6}{32}''$	19	Strong: regular: slightly harsh.
024/3	(26/4/3)	Small 26/4 type: good opening ...	35·6	4·3	7·8	$1\frac{4}{32}''$	25	Fairly strong: regular.
025/3	(26/4/4)	Similar 26/4 type	35·0	4·0	7·4	$1\frac{5}{32}''$	24	Fairly strong: regular
029/2	(26/A)	Well grown /26 type; fruiting freely and opening well.	34·8	4·0	7·5	$1\frac{1}{32}''$	29	Strong: regular: silky.
0211/2	(26/H)	Short plants: opening well... ...	34·2	3·9	7·5	$1\frac{6\frac{5}{2}}{32}''$	27	Fair strength: fairly regular: silky.
042/3	(34/2/1)	Semi-erect: very fruitful: heavy top crop.	33·6	4·3	8·5	$1\frac{6}{32}''$	29	Strong: regular: rather harsh.
043/3	(34/2/2)	Similar type but not fruiting so heavily.	33·9	4·3	8·3	$1\frac{4}{32}''$	25	Fairly strong: harsh.
065/3	(78/2/4)	Fruiting well; good type: fairly close internodes.	29·5	3·8	9·1	$1\frac{7}{32}''$	19	Fairly strong: regular: silky.
067/3	(78/3/5)	Excellent 78/3 type; fairly close internodes: good top crop.	33·7	4·3	8·5	$1\frac{2}{32}''$	26	Fairly strong: regular: harsh.
068/3	(78/3/7)	Moderate on poorish soil	31·2	4·0	8·9	$1\frac{9}{32}''$	24	Slightly weak: silky
074/3	(106/2/2)	Fruiting fairly well: more open than 106/2 type.	31·7	4·2	9·1	$1\frac{4}{32}''$	30	Strong: harsh.
076/3	(106/2/4)	Vigorous, late, compact: very close internodes.	35·5	4·6	8·3	$1\frac{3}{32}''$	29	Strong: irregular: harsh.
078/3	(106/3/2)	Fruiting freely: moderately open ...	34·6	4·5	8·4	$1\frac{5}{32}''$	24	Rather weak: irregular: harsh.
091/2	(130/A)	Good /130 type: moderately vigorous	32·9	4·2	8·6	$1\frac{2}{32}''$	24	Fairly strong: regular: silky.
0162/3	(104/1/1)	Distinctive leafy type: stiff: erect	32·4	4·8	9·9	$1\frac{1\frac{0}{2}}{32}''$	20	Fairly strong: regular: rather harsh.

as the Baer Diagram as a means of arriving at a mean figure for length, and as a measure of the ultimate length variations in a picking. With the facilities available, hair-weight per centimetre measurements could not be made accurately, and not much success has been attained with attempts to classify strains according to the percentages of mature and immature hairs. The lint quality classification of strains is done by hand examination.

It has been felt that some of the Gatooma strains which are highly promising agriculturally, for example, /26/4, had a tendency to produce soft lint when growing under difficult conditions, and that for this reason, there would be a risk in carrying them on. This view was confirmed when samples of these strains were referred to the Manager of the Central Co-operative Cotton Exchange, Limited, Durban (Mr. T. G. Hesse), and the Government Seed Cotton Classifier (Mr. J. Z. Boshoff), together with samples of what were thought to be the better quality strains.

Carefully sampled lots sent home for brokers' opinion agreed with the graders' placing, and showed a premium of 20 points for /64 over /26/4 and /106/2, a further 15 points for /64/7, and a still further premium of 15 points for /78/3, with middling American standing at just under sixpence.

The reports of the spinning tests and the hair character determinations, on these same samples state however that the differences between the cottons are slight, and that throughout the behaviour was generally satisfactory and the strength fairly good. If anything, they place /106/2 and /26/4 above /64 and /64/7. There is thus some uncertainty as to their respective merits. In the meantime, considering their potential agricultural value, /26/4 and /106/2 are being carried on and further selections made.

It will not be worth while sending home further lots this year in view of the difficulties of the season. But it has been planned to take the samples for the coming year from carefully replicated substrain trials in order to eliminate as far as possible quality differences governed by uncontrollable, environmental factors.

Spacing.

It was suggested to growers last season, that in view of the results which were being obtained, at least a portion of their acreage might be planted at a closer spacing than had been the practice, and that, whatever the spacing in the row aimed at, every effort should be made to obtain a good stand, the apparent advantages of closer spacing being lost unless the stand is good. A spacing of approximately six inches

in the row was suggested, or, as an alternative, two plants to a hill at about twelve inches. The advantages and possible dangers were discussed.

This past season the great majority of the growers in the country adopted this closer spacing for their commercial crops. The results generally seemed to have been satisfactory, in this, a dry season. It was noticed markedly that at the wider spacings only a small to moderate proportion of the top crop made after the March rains came through to maturity. The early crop was the important one. Records have come in from a number of crops, where the estimated yields were around 500 lbs. seed cotton per acre, but which actually yielded 750 to 800 lbs., undoubtedly due to the close spacing and the excellence of the stand. From careful observations made when touring and from such trial figures as are available, it would seem that had a relatively wider spacing been adopted generally, the mean yields would have been lower. It is realised that the advantages of the fairly close spacings have shown up in years of moderate rainfall and bollworm attack. It will be necessary to await the results obtained in a really wet year before generalising too much.

A closer spacing than six inches in the row on land at all good might be unwise, leading to too much early forcing up of the plants. Occasionally where the close spacing did not appear to have given very satisfactory results, it was found that the thinning had been delayed until the plants were too big, or that they had been forced up by weeds. An objection has been raised that a spacing as close as six inches in the row increased the expenses of weeding where the land was dirty, as it was difficult to get hoes between the plants. Two plants to a hill at twelve inches would then probably be a better spacing in the row under these conditions.

On the Station, and in touring, careful attention was paid to the type of growth that was being obtained where the plants were allowed more space, for example, in a patchy stand on a closely spaced field. It seemed that generally, with the season experienced, the more widely spaced plants were not making sufficient use of the area they occupied, and that the more closely spaced areas were yielding more heavily. On the Station, three sets of trials of spacing in the row were laid down, one already mentioned where /64 and Mixed Bulk were compared at the four spacings 6, 12, 18 and 24 inches in the row ; one where the three spacings 6, 12 and 24 inches were compared, with one plant and with two plants to a hill ; and one, which was a failure, on a piece of land that responded badly to the drought, comparing the yields at closer spacings, 3, 6 and 9 inches. All were laid down as Latin Squares, and the results worked out on a 1% value for Z.

TABLE IV.

COMBINED, STRAIN AND SPACING, YIELD TRIAL.

LATIN SQUARE 8 × 8 PLOTS: PLOT SIZE 1/31·1 ACRES.

Treatments.	U.4/64 at 6″.	U.4/M.B. at 6″.	U.4/64 at 12″.	U.4/M.B. at 12″.	U.4/64 at 18″.	U.4/M.B. at 18″.	U.4/64 at 24″.	U.4/M.B. at 24″.	*Mean.*	*Criterion of Significance* P=·05.
Yields of 8 plots, seed cotton	68·4 lbs.	57·0 lbs.	53·5 lbs.	47·1 lbs.	47·5 lbs.	37·3 lbs.	42·0 lbs.	34·5 lbs.	48·4 lbs.	—
Yields per acre, seed cotton	267 lbs.	222 lbs.	209 lbs.	184 lbs.	185 lbs.	146 lbs.	164 lbs.	135 lbs.	188 lbs.	16·9
% Yields per acre, seed cotton	142·2	118·5	111·5	98·0	99·0	77·5	87·4	71·6	100·0	9·0
Yield per acre, lint	84·0 lbs.	77·7 lbs.	65·8 lbs.	61·3 lbs.	60·3 lbs.	52·1 lbs.	51·6 lbs.	46·6 lbs.	62·4 lbs.	6·2
% Yield per acre, lint	134·4	124·4	105·5	98·1	96·5	83·5	82·7	74·5	100·0	10·0
% Stand at harvest	81	72	86	73	86	74	87	73	—	—

TABLE V.

ANALYSES OF BOLL-SHEDDING IN STRAIN AND SPACING TRIAL.

Treatment.		U.4/ *Mixed Bulk.*				U.4/64.			
		6″.	12″.	18″.	24″.	6″.	12″.	18″.	24″.
Percentage of total boll-shedding recorded as—	(*a*) Physiological	% 50·5	% 42·5	% 39·9	% 31·0	% 59·0	% 47·5	% 39·0	% 39·0
	(*b*) Bollworm Punctured ...	49·5	57·5	60·1	69·0	41·0	52·5	61·0	61·0
Percentage of total Flowering accounted for as—	Loss in Recorded— (*a*) Boll-shedding	67·5	70·0	78·0	76·0	75·5	71·2	68·5	75·0
	(*b*) Bolls Harvested ...	22·0	21·7	23·6	24·0	23·1	21·8	21·5	22·1
	(*c*) Unapportioned error ...	10·5	8·3	−1·6	—	1·4	7·0	10·0	2·9

In Table IV are set out the results of the strain and spacing trial. The poorer stand throughout of Mixed Bulk makes the strain comparisons of less value but, though the yields are low both with /64 and Mixed Bulk, the increased yields at the closer spacings are very definitely significant.

In Fig. 9 are graphed the development records for these trials, showing clearly the advantage in early flowering possessed by the closer spaced plots. The dip in flowering at the beginning of March is interesting, a reflection of a similar growth dip (Fig. 4), nearly a month earlier. In Fig. 7 are graphed the analyses of shedding. The earlier and heavier physiological shedding at the closer spacings is demonstrated.

The peak in the 24-inch shedding curve comes approximately a fortnight later than the peak in the 6-inch curve, showing the earlier and more serious nature of the strain on the closely spaced plants.

The results of the second trial, one plant per hill and two plants per hill, at the three spacings 6, 12 and 24 inches in the row, are shown in Table VI, and the development records are graphed in Fig. 10. Again the yields per acre are poor. The closer spacings are significantly the heavier yielders, but, owing probably to the poor yields, at none of the spacings is the yield with two plants per hill significantly heavier than with one plant per hill. With the season experienced, there were practically no differences in lint quality, nor in the ginning percentages between the lots at the close and the wide spacings.

On the Station an inter-row spacing trial was laid down, comparing spacings of 4 feet and 3 feet 3 inches between the rows : the differences were not significant.

The development records for a spacing trial at Keendale, Bulawayo (F. E. Goodridge), are graphed in Fig. 11 : again the advantages of the closer spacing are brought out. Similar results are shown in the development records at Sandazi, Mazoe (Messrs. Simpson Brothers)—Fig. 12—namely, the heavier early and total flowering at the closer spacings, and the effect of this on the final yield this season.

In the district trials, results from which are shown in Table VII, the yields at 6 inches spacing are not significantly heavier than the yields at 12 inches, but differences of stand come in. In all three sets of trials the yields, at 6 inches and 12 inches, were significantly heavier than at 24 inches. The development records at Msengi, Lomagundi (G. H. Cautherly), are graphed in Fig. 8, showing the better early flowering at the closer spacings, but the greater recovery at the 24-inch spacing, much of which recovery was ineffective. In the actual trials the better percentage stand of the 12-inch plots favours them as against the 6-inch plots.

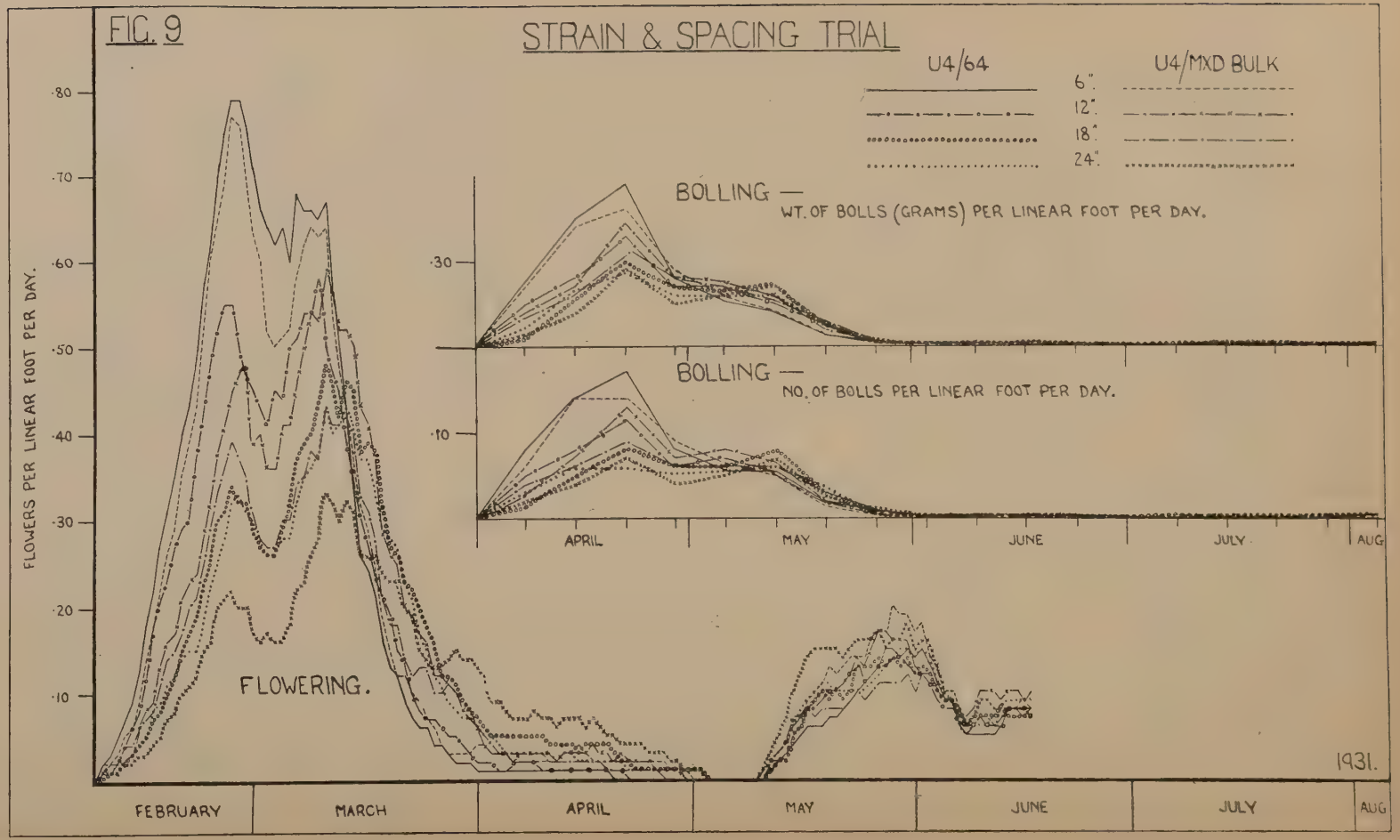


FIG. 9
STRAIN & SPACING TRIAL
U4/64
U4/MXD BULK
6".
12".
18".
24".
BOLLING — WT. OF BOLLS (GRAMS) PER LINEAR FOOT PER DAY.
BOLLING — NO. OF BOLLS PER LINEAR FOOT PER DAY.
FLOWERS PER LINEAR FOOT PER DAY.
·80
·70
·60
·50
·40
·30
·20
·10
·30
·10
FLOWERING.
APRIL
MAY
JUNE
JULY
AUG
1931.
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
AUG

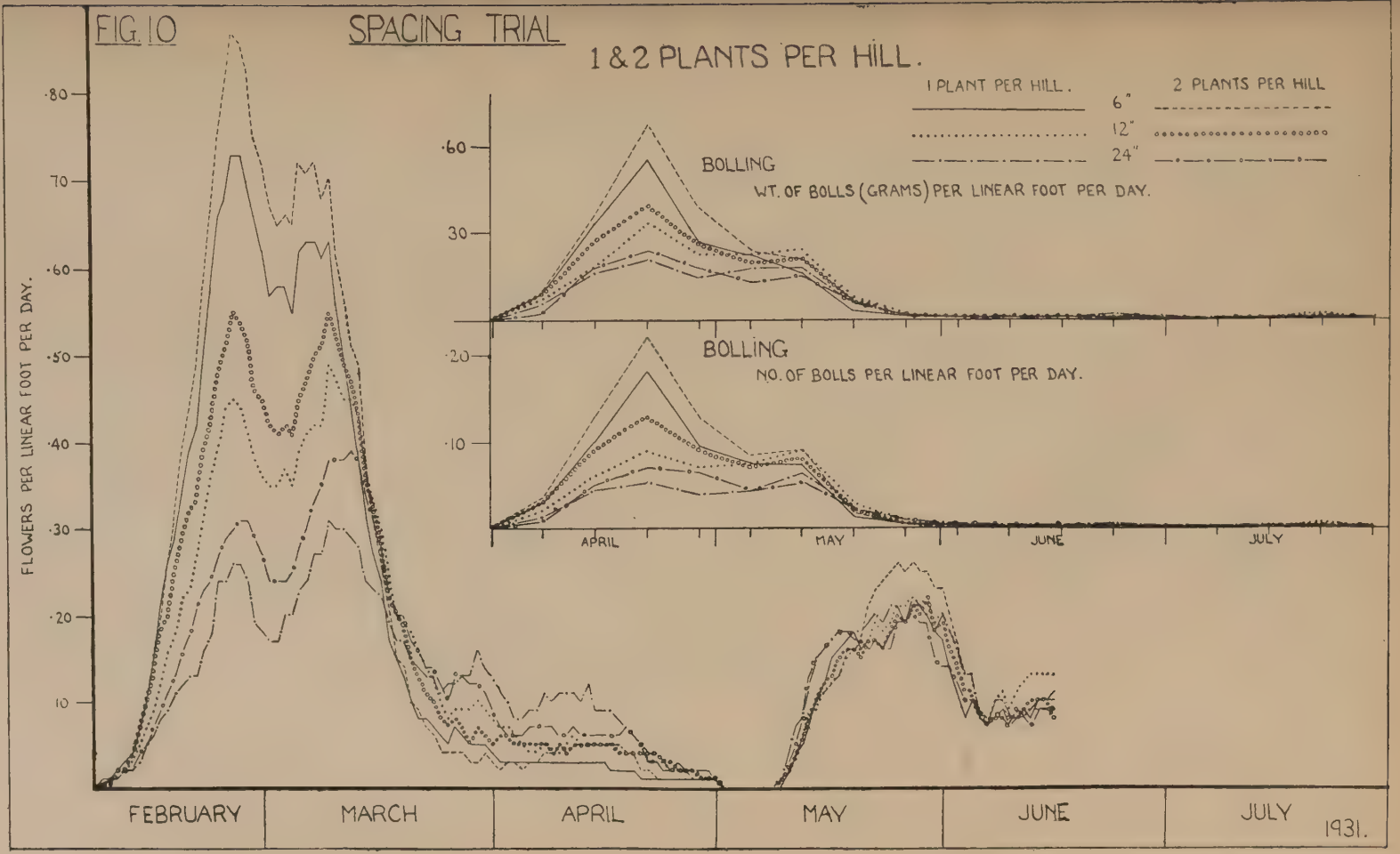


FIG. 10
SPACING TRIAL
1 & 2 PLANTS PER HILL.
1 PLANT PER HILL.
2 PLANTS PER HILL
6"
12"
24"
BOLLING
WT. OF BOLLS (GRAMS) PER LINEAR FOOT PER DAY.
BOLLING
NO. OF BOLLS PER LINEAR FOOT PER DAY.
FLOWERS PER LINEAR FOOT PER DAY.
·80
70
·60
·50
·40
·30
·20
10
·60
30
·20
·10
APRIL
MAY
JUNE
JULY
FEBRUARY
MARCH
APRIL
MAY
JUNE
JULY
1931.

TABLE VI.

YIELD TRIAL—1 AND 2 PLANTS PER HILL AT THREE, INTRA-ROW SPACINGS.

LATIN SQUARE 6 × 6 PLOTS: PLOT SIZE 1/31·1 ACRES. STRAIN U.4/64.

Treatment. No. of plants and spacing.		*Two at 6″.*	*One at 6″.*	*Two at 12″.*	*One at 12″.*	*Two at 24″.*	*One at 24″.*	*Mean.*	*Criterion of significance. P=·05.*
Yield of 6 plots, lbs. seed cotton		52·7	48·7	43·9	39·7	33·7	29·6	41·4	6·6
Yield per acre, lbs. seed cotton		274	253	228	206	175	154	215	34·3
Percentage yield per acre, seed cotton		127·0	118·0	106·0	96·0	81·5	71·5	100	15·9
First and second pickings as percentages of final yield	First picking	73·5	71·8	72·4	62·5	65·5	57·0	—	—
	Second picking	26·5	28·1	27·6	37·5	34·5	43·0	—	—
Analysis of stand at harvest	Percentage stand (hills) ...	85	83	89	87	92	90	—	—
	Percentage doubles	82	—	85	—	84	—	—	—
	Percentage singles	3	83	4	87	8	90	—	—
	Percentage blanks	15	17	11	13	8	10	—	—
	Total	100	100	100	100	100	100	—	—

TABLE VII.

District Yield Trials—Spacing.

Locality.	*Trial Layout.*		*Spacing.* 6″.	*Spacing.* 12″.	*Mean Difference 12 pairs of comparable Plots.*	*Significance — Odds.*	*Spacing.* 12″.	*Spacing.* 24″.	*Mean Difference 12 pairs of comparable Plots.*	*Significance — Odds.*
Banket. W. A. Beattie. Dunphaile.	Half-drill strip, 12 replications; plots 1/46·1 acres.	Total plot yield, lbs. seed cotton.	62·0	58·5	+·29 ± ·31	Not significant.	58·5	50·5	+·67 ± ·24	50 : 1
		Equivalent yield per acre.	236	222	+14	Not significant.	222	192	+30	
Sinoia. M. A. Graham. Mafoota.	As above.	Total plot yield, lbs. seed cotton.	181·5	178·5	+·25 ± ·82	Not significant.	178·5	157·0	+1·80 ± ·37	100 : 1
		Equivalent yield per acre.	690	678	+12	Not significant.	678	597	+81	
Eldorado. G. H. Cautherley. Msengi No. 1.	As above.	Total plot yield, lbs. seed cotton.	83·5	80·0	+·30 ± ·48	Not significant.	80·0	67·5	+1·04 ± ·41	27 : 1
		Equivalent yield per acre.	317	284	+33	Not significant.	284	256	+28	
Eldorado. G. H. Cautherley. Msengi No. 2.	As above, but only 9 comparisons for 6″ and 12″, and 10 for 12″ and 24″.	Total plot yield, lbs. seed cotton.	92·9	115·3	−2·50 ± ·47	Greater than 100 : 1	124·3	99·7	+2·46 ± ·35	Greater than 100 : 1
		Equivalent yield per acre.	474	588	−114	Greater than 100 : 1	572	459	+113	
Spacing in the Eldorado trials. G. H. Cautherley.	No. 1.	Theoretical spacing	6″	12″	24″					
		Observed Mean Spacing.	8·7″	13″	21·6″					
		Percentage stand	69·5	90·5	109·8					
	No. 2.	Theoretical spacing	6″	12″	24″					
		Observed Mean Spacing.	8·5″	12″	22·5″					
		Percentage Stand	70·0	101·0	107·0					

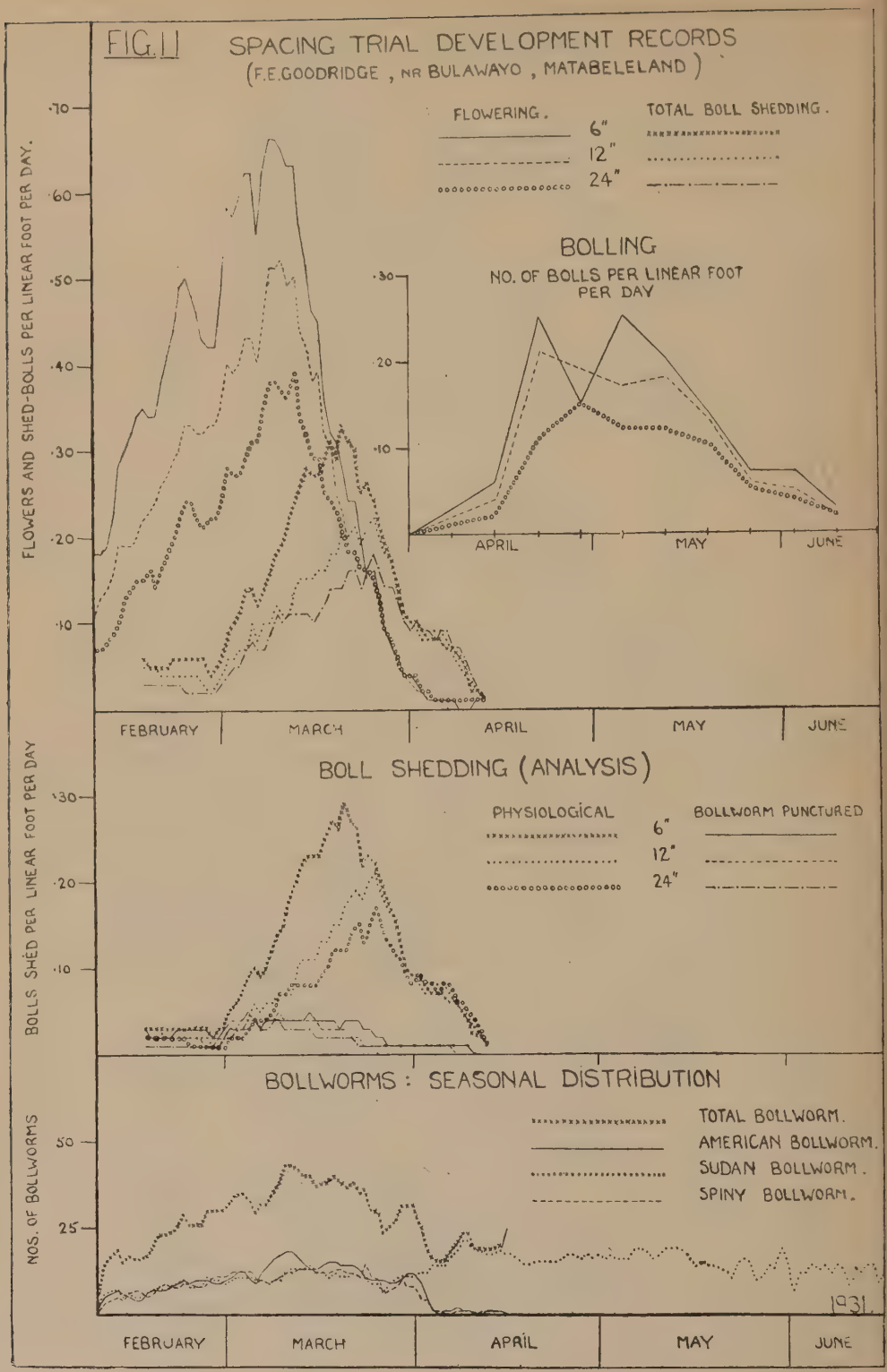
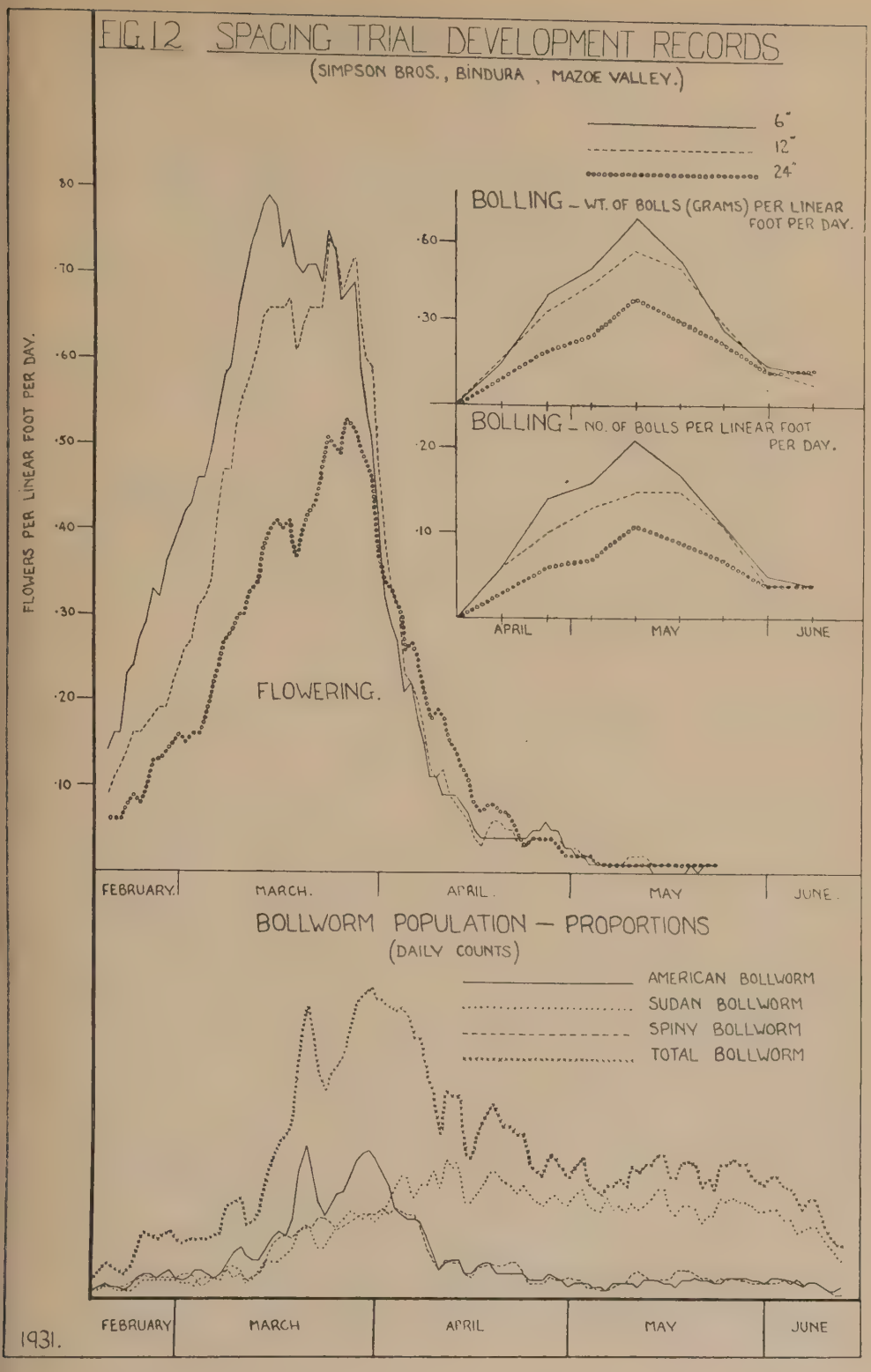


FIG. 11
SPACING TRIAL DEVELOPMENT RECORDS
(F.E.GOODRIDGE, NR BULAWAYO, MATABELELAND)
FLOWERING.
TOTAL BOLL SHEDDING.
6"
12"
24"
FLOWERS AND SHED-BOLLS PER LINEAR FOOT PER DAY.
·70
·60
·50
·40
·30
·20
·10
BOLLING
NO. OF BOLLS PER LINEAR FOOT PER DAY
·30
·20
·10
APRIL
MAY
JUNE
FEBRUARY
MARCH
APRIL
MAY
JUNE
BOLL SHEDDING (ANALYSIS)
BOLLS SHED PER LINEAR FOOT PER DAY
·30
·20
·10
PHYSIOLOGICAL
BOLLWORM PUNCTURED
6"
12"
24"
BOLLWORMS: SEASONAL DISTRIBUTION
NOS. OF BOLLWORMS
50
25
TOTAL BOLLWORM.
AMERICAN BOLLWORM.
SUDAN BOLLWORM.
SPINY BOLLWORM.
1931
FEBRUARY
MARCH
APRIL
MAY
JUNE

FIG. 12 SPACING TRIAL DEVELOPMENT RECORDS

(SIMPSON BROS., BINDURA, MAZOE VALLEY.)



1931.

Fertilising.

The observations and results of the year as regards fertilising are in complete agreement with those of last year. Neither on the Station nor when touring was there much evidence of improvements in yield or quality as a result of the surface application of fertilisers at the time of planting. Possibly more satisfactory responses to fertilising would be obtained in a season of heavier rainfall. On the Station, three sets of plots were laid down with a wide range of fertiliser applications, varying combinations and amounts. No differences of any value were noted between the plots. The land has been carefully ploughed, and this coming season will be replanted to cotton, to observe the effects the second year after application.

Trials were also laid down on the Station to test the possible benefits of applications of 150 lbs. per acre and 400 lbs. per acre respectively of superphosphate, and of 150 lbs. per acre of muriate of potash. The potash did not give significantly heavier yields, but the small increases due to the superphosphate applications were both significant (Table VIII).

TABLE VIII.

FERTILISER YIELD TRIALS.

Half-Drill Strip Layout, 12 Replications of each Treatment: Plots 1/31·1 Acres.

1. Superphosphate (19·5%, Total P_2O_5).

Treatment.	150 *lbs. supers per acre.*	*No. supers.*	*Mean difference for 12 pairs of comparable plots.*	*Significance — Odds.*	400 *lbs. supers per acre.*	150 *lbs. supers per acre.*	*Mean difference for 12 pairs of comparable plots.*	*Significance — Odds.*
Total plot yield, lbs. seed cotton	99·7	91·1	+·72 ± ·23	100:1	105·5	99·7	+·48 ± ·17	66:1
Equivalent yield per acre, lbs.	259	237	+22		274	259	+15	

2. Potash (60%, K_2O).

Treatment.	150 *lbs. muriate of potash per acre.*	*No. potash.*	*Mean difference for 12 pairs of comparable plots.*	*Significance — Odds.*
Total plot yield, lbs. seed cotton	88·5	90·9	−·20 ± ·27	Not
Equivalent yield per acre, lbs.	230	236	−6	significant

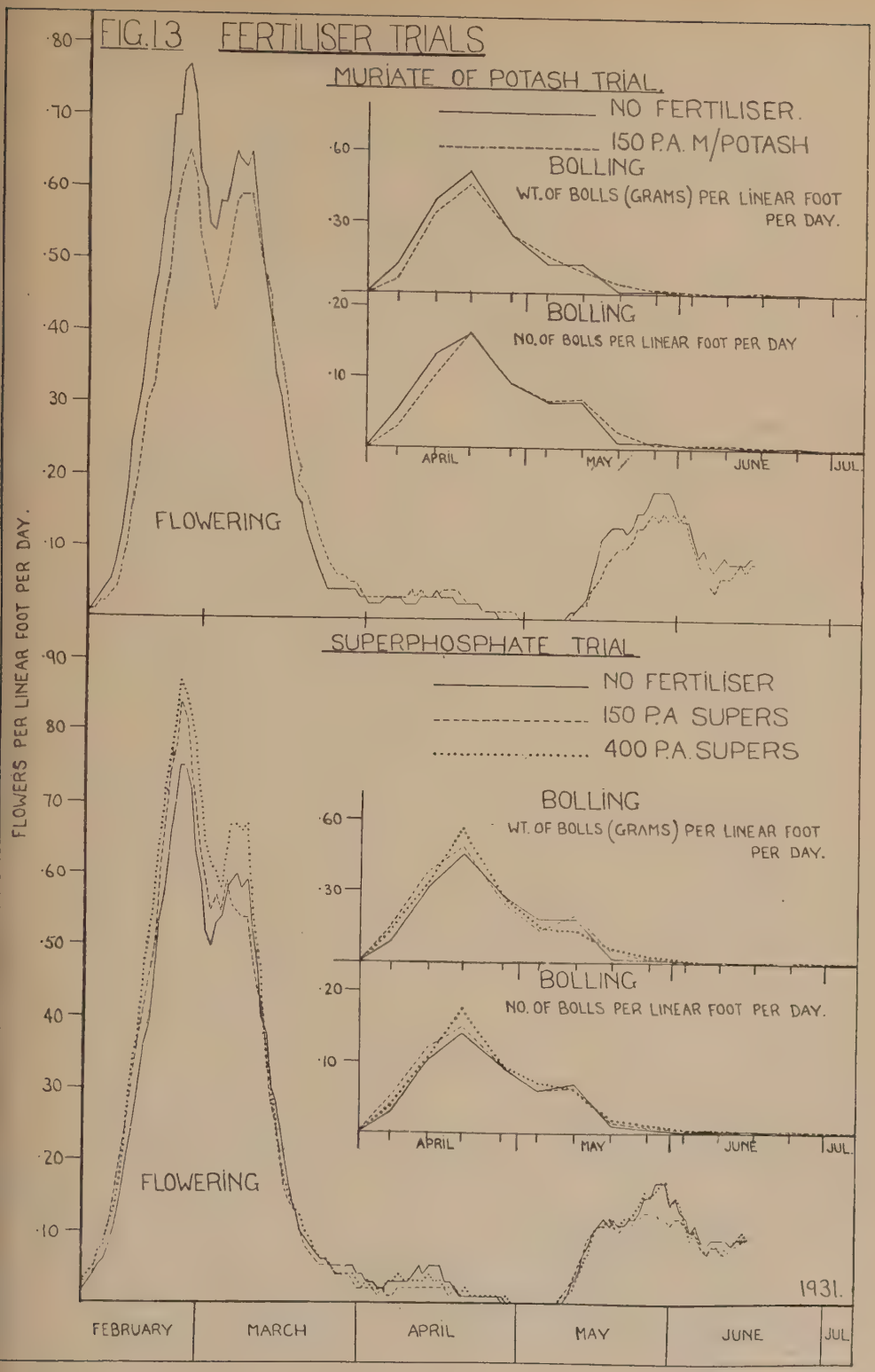


FIG.13 FERTILISER TRIALS
MURIATE OF POTASH TRIAL.
NO FERTILISER.
150 P.A. M/POTASH
BOLLING
WT. OF BOLLS (GRAMS) PER LINEAR FOOT PER DAY.
BOLLING
NO. OF BOLLS PER LINEAR FOOT PER DAY
APRIL
MAY
JUNE
JUL.
FLOWERING
SUPERPHOSPHATE TRIAL
NO FERTILISER
150 P.A SUPERS
400 P.A. SUPERS
BOLLING
WT. OF BOLLS (GRAMS) PER LINEAR FOOT PER DAY.
BOLLING
NO. OF BOLLS PER LINEAR FOOT PER DAY.
APRIL
MAY
JUNE
JUL.
FLOWERING
1931.
FLOWERS PER LINEAR FOOT PER DAY.
FEBRUARY
MARCH
APRIL
MAY
JUNE
JUL.

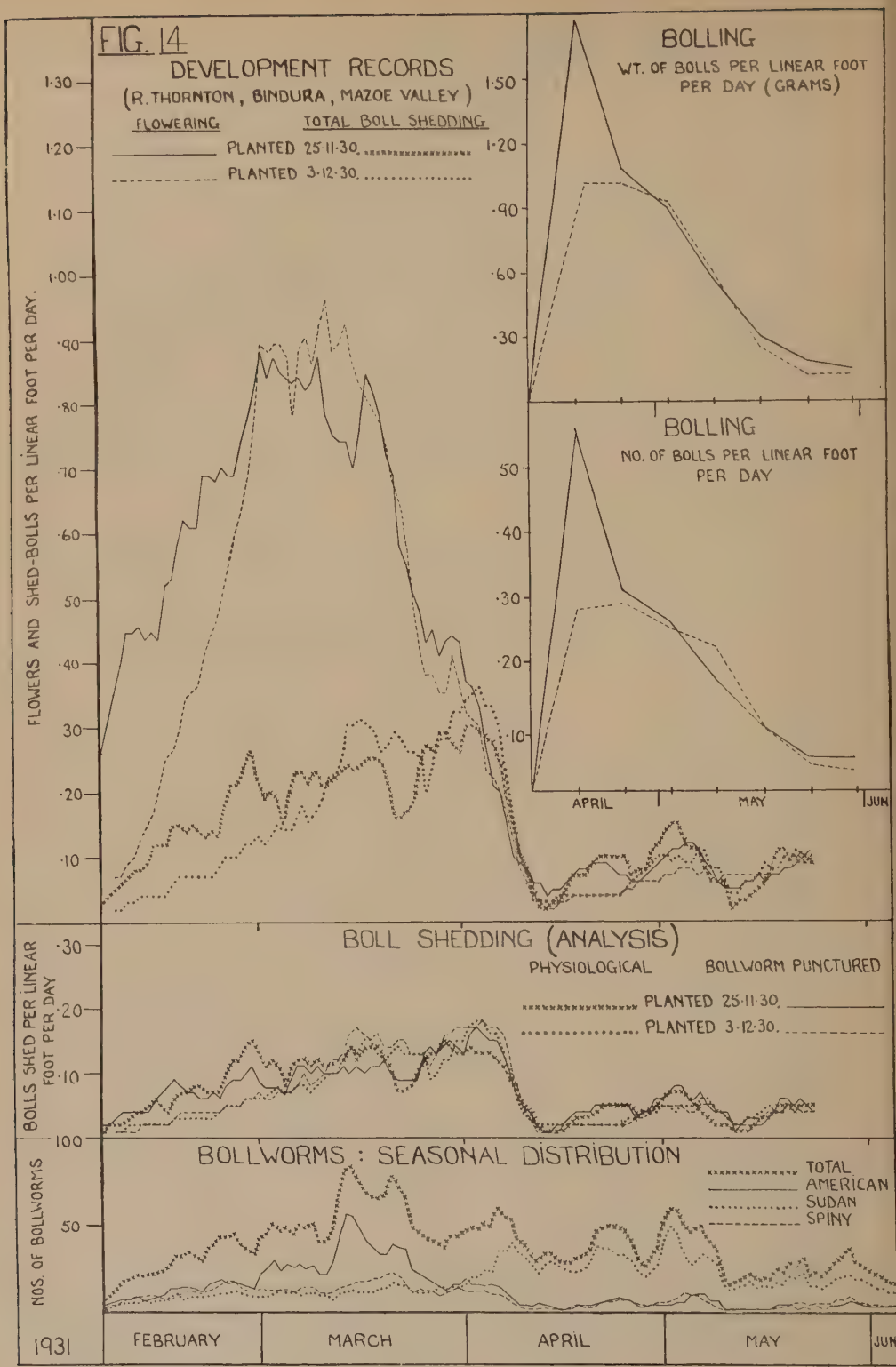


FIG. 14
DEVELOPMENT RECORDS
(R. THORNTON, BINDURA, MAZOE VALLEY)
FLOWERING
TOTAL BOLL SHEDDING
PLANTED 25·11·30.
PLANTED 3·12·30.
FLOWERS AND SHED-BOLLS PER LINEAR FOOT PER DAY.
1·30
1·20
1·10
1·00
·90
·80
·70
·60
·50
·40
·30
·20
·10
BOLLING
WT. OF BOLLS PER LINEAR FOOT PER DAY (GRAMS)
1·50
1·20
·90
·60
·30
BOLLING
NO. OF BOLLS PER LINEAR FOOT PER DAY
50
·40
·30
·20
·10
APRIL
MAY
JUN
BOLL SHEDDING (ANALYSIS)
PHYSIOLOGICAL
BOLLWORM PUNCTURED
PLANTED 25·11·30.
PLANTED 3·12·30.
BOLLS SHED PER LINEAR FOOT PER DAY
·30
·20
·10
100
BOLLWORMS : SEASONAL DISTRIBUTION
TOTAL
AMERICAN
SUDAN
SPINY
NOS. OF BOLLWORMS
50
1931
FEBRUARY
MARCH
APRIL
MAY
JUN

The development records are graphed in Fig. 13.

The type of growth obtained from an area in which sunn hemp was reaped for seed the previous year and only the roots ploughed in has already been mentioned. Satisfactory growth and yields considering the season were obtained from the lands where the whole sunn hemp crop had been ploughed in the previous year. The better results obtained where the whole crop had been ploughed in were due probably to the benefits from the added humus. The soil on the Cotton Station is definitely deficient in humus.

Out-Station Records.

Reference has been made in the report, under the headings bollworms, strain trials, and spacing trials, to the graphs, Figs. 8, 11, 12 and 14, recording plant development at the four farms where native recorders were stationed during the past season. Comparisons of these graphs with the Station graphs are interesting if only as comparisons of plant response in relation to the season experienced. The Station graphs show the satisfactory early flowering curves cut short by the drought and the added effects of a moderate bollworm attack. The attempt made by the plants at recovery is shown and, in the bolling curve, the low percentage of the crop finally matured.

At Keendale, Bulawayo, Matabeleland (F. E. Goodridge), the drought was more serious than on the Station, but the early rains were fairly good and the sandstone formation must have excellent powers of moisture retention compared to the felsite and diorite formations in Hartley, Lomagundi and Mazoe. The bollworm loss was small; although the flowering curve was quickly cut short, and despite the shedding caused by the drought, the absence of a serious bollworm attack allowed a reasonable crop of 400–500 lbs. per acre of seed cotton to mature. As can be seen (Fig. 11), the crop ripened in one picking, and was of fairly good quality.

At Msengi, Lomagundi (G. H. Cautherley), the season was entirely different, and this is demonstrated by the graphs, Fig. 8. The early rains were heavy and the drought when it came was not so severe as at Gatooma, added to which the soil moisture reserves must have been better. Plants had grown out well. There must have been a certain loss from the effects of the drought on the sappy plants, but the big loss was caused by the heavy and continuous American bollworm attack. The flowering curves are in marked contrast to those from Keendale—a low rate of flowering over four months with a substantial top crop towards the end of March as a result of the mid-March rains.

The protracted nature of the fruiting is also shown. The final crop yields were similar to those at Keendale, but were arrived at in a completely different way.

In parts of Mazoe Valley the season was moderately good, climatically. There was a short February–March drought at a critical time in the life of the plant, but not as bad as in many parts of Lomagundi, and not nearly as bad as the drought experienced at Gatooma. Early rains were excellent and growth was good, except in occasional areas where local dry spells were experienced. At Avoca, Bindura (R. Thornton), there was a moderate bollworm attack, but the loss in shedding due to bollworm almost equalled the loss due to physiological shedding. The flowering curves were quite good, but cut short by the period of drought. The type of crop reaped, around 750 lbs. per acre seed cotton, is shown in the bolling curves. The curves from Sandazi, Bindura (Messrs. Simpson Brothers), show a somewhat similar type of flowering, but with a much heavier loss from shedding.

Rotation Crops.

Owing to financial stringency, there has been a considerable reduction in the amount of the Government grant for the work of the Station; this must cover the additional cost of Station extension work, including travelling, and district recording. In order that there may be as slight a check as possible to the development of the cotton work, a minimum of labour will be devoted to rotation crops. More than one-third of the acreage broken up will be put out of cultivation and the acreage under maize is being much reduced. A small acreage of ground-nuts will be planted for boys' food, and it is hoped that it will be possible to continue each year with a portion of the acreage under green manure crop.

NORTHERN RHODESIA.

REPORT ON THE WORK ON COTTON AT THE RESEARCH STATION, MAZABUKA, SEASON 1930-31.

SUMMARY OF RESULTS
BY
A. G. BEBBINGTON AND W. ALLAN.

Season.

Although the rainfall registered on the Station during the season was similar in amount to that of 1929-30, conditions throughout were much more dry. Ploughing rains fell earlier than usual, and planting commenced on the 2nd December making good headway until the 10th. On this day an exceedingly violent storm occurred on the Station when 5.6 inches of rain fell in a period of just over 2 hours. This storm, which was entirely local, caused serious soil erosion on some plots, and all land had to be ploughed again, and replanted. This delay resulted in planting not being completed until the 29th December, a considerable proportion of the crop being planted so late as to detract considerably from its value.

During January the Station was visited by another storm, 2.58 inches of rain falling in 3/4 hour. This rain re-opened the wash channels caused by the previous storm, and greatly reduced the stand on some plots.

Temperatures during the season were on a generally higher level than during the past two years, while humidity was considerably lower. Drought conditions prevailed throughout the season over the greater part of North Western Rhodesia, and maize yields were seriously affected.

So far as can be judged, the season under review was similar to the very successful cotton year of 1923-24, and yields of cotton were considerably higher than during the past two years. The crop matured very early, the first bolls opening a full month earlier than in the 1929-30 season.

Jassid did not appear in any numbers during the season, even the susceptible variety, Arizona, showing very few signs of damage. Bollworm appeared in large numbers in March, but the attack in April was considerably less than in the previous season. Stainer (*Dysdercus*) appeared in large numbers in February and caused a considerable percentage of staining in all pickings.

Selections.

One hundred and thirty-seven single-plant lots drawn entirely from U.4 were planted.

Further selection on these was again very difficult, owing to the effect of different soil conditions on the plants. Two distinct soil types, which could be distinguished by the eye, were encountered in this field. One type was light coloured and sandy in texture while the other was darker in colour and of a heavier nature.

The plants on the first type were small and were carrying quite a large crop of clean cotton, while the plants on the darker type were tall and bushy carrying little or no crop, the cotton in nearly every case being stained to a greater or less degree.

These differences in yield and degree of staining on the two types of soil were examined more closely in a neighbouring field which exhibited the same types of soil.

The results of this examination are given in Table 3, below.

In the circumstances described it was not possible to carry out the normal methods of selection, and in consequence selection was restricted to plants from representative families occurring on both soil types.

As both the writers would be on leave during the planting season 1931-32, the number of plants so taken was restricted to forty-eight, while no fresh selections were made from bulk crops.

Variety Trial.

Five differently maturing strains of U.4 were tried out against U.4 Bulk, on a randomised block lay-out including eight replications. This trial was first planted on the 9th December, but had to be ploughed in after the heavy rain of the 10th. It was not finally planted until the 18th December, which was rather too late to give the information required. Flower counts and boll counts were carried out. No statistically significant results were obtained from this trial.

Time of Planting Experiment.

This was carried out with U.4 Bulk, weekly plantings being made from the 2nd December until 23rd January, with eight replications of each planting, on a randomised block lay-out. The first two plantings were badly washed by the heavy rain, the stand being very considerably reduced, and in consequence yields could only be finally taken from 50 plants in each plot. Flower counts and boll counts were carried out over all plantings. In addition, all squares on 40 plants of each planting were ticketed with their date of appearance each day, some 40,000 squares being so treated during the season. All shed squares and bolls from these plants were collected daily, and examined in the laboratory ; the mature bolls were also picked and examined.

This procedure was undertaken in order to obtain detailed information as to the effect of Time of Planting on shedding by

bollworm and stainer, on the damage caused by these pests to mature bolls, and also on the maturation period of the boll. Some of the results obtained are given in Tables 1, 2 and 4.

Time has not been available to work up the yield figures of this trial, but from inspection only the earlier dates would appear to have given better yields.

Small Bulks.

Multiplication plots of U.4 Bulk and various strains of U.4 were grown on the Station during the season. The best yield obtained was one of 600 lbs. seed cotton per acre from a plot of U.4 Bulk.

Seed Distribution.

Seed of U.4 Bulk and U.4/6 for five-acre plots was distributed to 29 farmers, but owing to various causes only 16 plots were planted, and of these four were abandoned. The average yield from those harvested was 256 lbs. seed cotton per acre, the highest yield being 410 lbs. and the lowest 66 lbs. per acre.

The grades obtained were better than in either of the previous seasons. The seven bales produced were classified by the South African Government grader as under:—

4 bales Middling Fair; 3 bales Good Middling. The staple was $1\frac{1}{16}$ins.

Insect Pests.

Bollworm. The only two species recorded were again *Chloridea obsoleta* and *Earias insulana*. Life history studies were carried out in conjunction with an endeavour to assess as precisely as possible the loss of crop to be attributed to bollworm injury, and to find the effect of time of planting on the loss due to bollworm. (See Time of Planting Expt. page 86). The main loss was due to the first generation of *C. obsoleta* and there was heavy shedding of squares and young bolls. For a reason which was not ascertained the second generation attack was comparatively light, and consequently the percentage of locks damaged by bollworm at the time of picking was low. Some of the final figures are tabulated as an indication of the results obtained.

TABLE I.

Time of planting.	*Total No. of squares set per plant.*	*% of Crop set shed owing to Bollworm.*	*% of Mature Crop destroyed by Bollworm.*
2.12.30	128·7	45·5	8·3
23.12.30	101·1	49·2	7·8
21.1.31...	46·1	27·1	3·2

In this season, although a certain amount of bollworm damage was shown to be avoided by late planting, the progressive falling off in the crop set by the later plantings more than counterbalanced this reduction in loss.

Stainer.—The four species previously associated with transmission of internal bollrots, *Dysdercus superstitiosus*, *D. fasciatus*, *D. intermedius*, and *Callidea dregei* again occurred.

Seasonal distribution studies were continued and in its main features the distribution of the species agreed with that found for previous years. Observations on alternate host plants were made, the most important in the Mazabuka district being *Thespesia rogersii*, Moore. The cycle of migration between Thespesia and cotton was studied. In control trials conducted as described in the report for 1929-30 it was found that continuous handpicking of all species, combined with trapping over the effective period, reduced staining by 30%, while continuous trapping resulted in a reduction of staining approximating to 24%. Handpicking alone appeared to be valueless, but complicating factors reduced the trustworthiness of the experiment. The amount of loss associated with boll puncturing was studied in the time of planting experiment. Representative figures are tabulated. In making the counts only discoloured lint of a reasonable strength was classified as "Saleable," while very badly discoloured and very weak lint was classified as "Unsaleable."

TABLE II.

Date of planting.	*Total No. of squares set per plant.*	*% Crop set shed owing to insect punctures.*	*% Locks stained, but saleable.*	*% Locks stained and unsaleable.*
2.12.30	128·7	10·6	20·1	48·9
23.12.30	101·1	13·4	14·2	64·8
21.1.31	46·1	10·2	18·2	74·5

It is probable that the percentage of staining in the later plantings is somewhat higher than it would have been had the plots been isolated, owing to an influx of stainers from the earlier planted plots.

An interesting indication that the type of plant produced on certain soils suffers less injury from stainer is being followed up. This was very strikingly demonstrated in a field containing reasonably pure small bulks. Two soil types which could readily be distinguished by the eye were present in this field. It was noticed that plants growing on the lighter soil type were giving a much higher and cleaner yield of seed cotton than plants of the same strain growing on the heavier and darker soil type.

Unfortunately it was impossible to carry out a complete analysis of the cause of the differences in the crop from the two soil types. One random sample of ten plants was taken from the dark soil, and a similar sample of the same strain from the light. All bolls were stripped from the plants and examined as in the case of the Stainer Control Experiments. Three strains in all were so examined for degree of staining.

TABLE III.

Strain.	*Soil type.*	*No. Locks examined (ten plants).*	*% Locks stained but saleable.*	*% Locks stained and unsaleable.*	*Yield of seed cotton (ten plants).*
					Lbs.
U.4/151/2 ...	Dark soil	563	7·4	69·3	0·2
	Light soil	743	19·8	22·1	1·1
U.4/167/2 ...	Dark soil	668	14·5	38·5	0·6
	Light soil	844	23·9	27·0	1·3
U.4/5/6 ...	Dark soil	748	10·8	40·8	0·5
	Light soil	977	20·4	25·0	1·5

While the total percentage of staining is similar within each strain, except in the first case, the amount of rotted and unsaleable cotton is in every case markedly less in plants from the lighter soil type, while such plants are also invariably more productive. The plants on the darker soil were tall and bushy and retained their leaves throughout the season whereas plants on the lighter soil were small and shed their leaves. It is suggested that the difference in staining is due to a difference in stainer population resulting from the varying amount of shade provided by the two types of growth. Similar indications have been obtained from the external plots, while the effect on the stainer of absence of shade has been demonstrated both in the field and in the insectary.

Other Causes of Shedding.

In order to complete the record of total losses, the figures for physiological shedding and for shedding due to undetermined causes must be added. In making the examination, shed bolls and squares which appeared to be perfectly undamaged were recorded as "physiological shedding." Shed bolls and squares obviously damaged, but in such a manner that the cause could not be determined, were recorded as "Shedding due to undetermined causes." The great majority of the latter were small bolls completely rotted and blackened, and it seems probable that a certain amount of this damage is due to early stainer puncturing.

TABLE IV.

Date of planting.	*Total No. of squares set per plant.*	*% Crop set shed physiologically.*	*% Crop set shed due to undetermined causes.*
2.12.30	128·7	7·8	16·1
23.12.30	101·1	6·1	21·7
21.1.31	46·1	9·0	27·3

Jassid and Aphis.—The usual records were kept, but the season has again been one of low jassid incidence.

CENTRAL RESEARCH STATION, MAZABUKA.

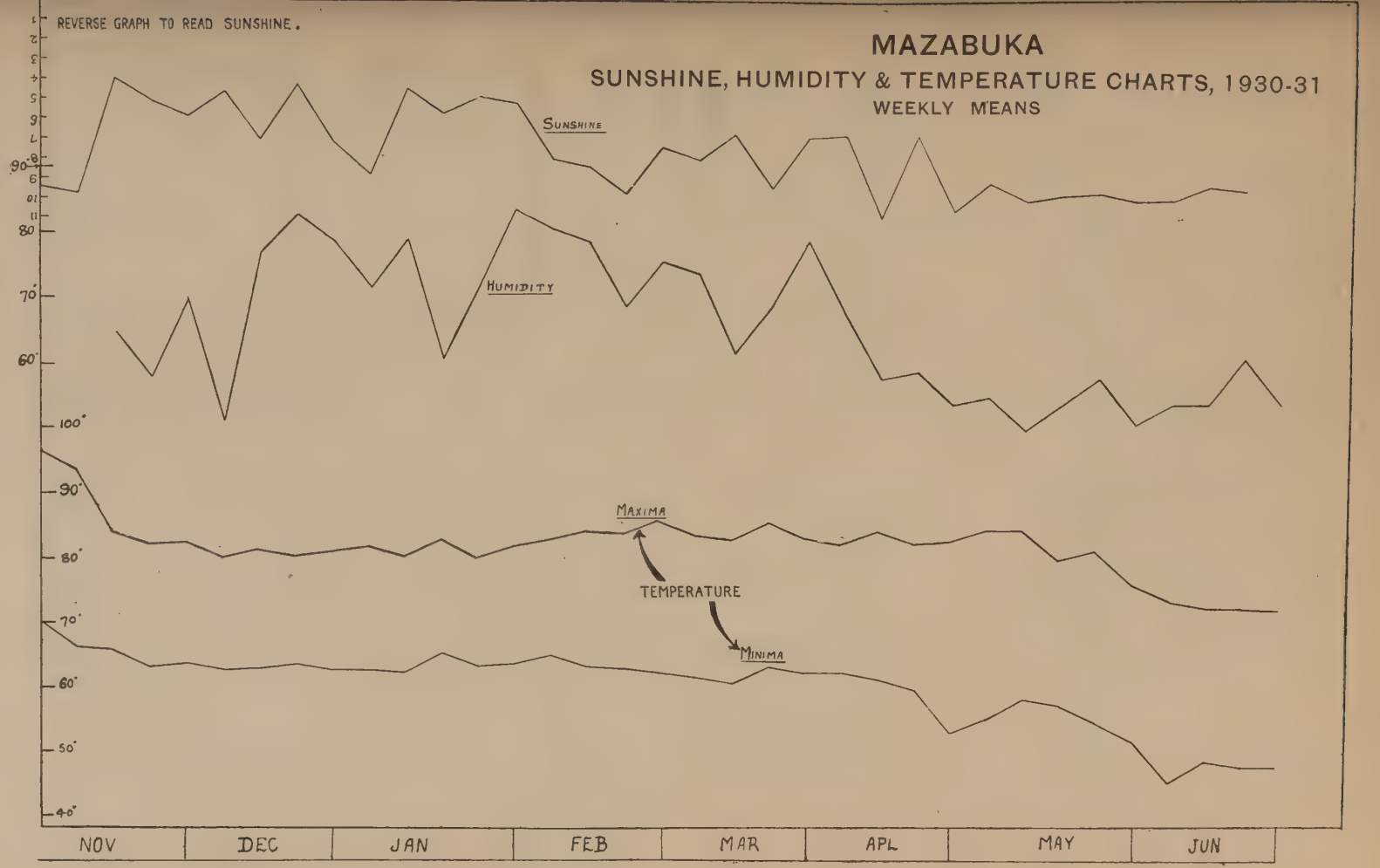
DAILY RAINFALL.

SEASON 1930–31.

	Nov.	*Dec.*	*Jan.*	*Feb.*	*Mar.*	*Apr.*	*May.*
1 ...	—	0·19	—	1·24	0·13	0·09	—
2 ...	—	0·16	—	—	0·51	—	—
3 ...	—	—	0·34	0·01	—	—	—
4 ...	—	—	—	Tr.	—	—	—
5 ...	Tr.	—	—	0·03	—	—	—
6 ...	0·06	0·63	—	—	0·03	—	—
7 ...	—	0·01	0·19	1·15	—	—	—
8 ...	—	0·01	—	—	0·05	—	—
9 ...	—	0·80	—	0·12	—	—	—
10 ...	—	5·60	—	—	—	—	—
11 ...	—	—	0·33	—	—	—	—
12 ...	—	0·08	—	—	—	—	—
13 ...	—	—	2·58	—	—	—	—
14 ...	—	—	—	—	—	—	—
15 ...	0·64	—	—	—	—	—	—
16 ...	—	0·06	—	—	0·03	—	0·04
17 ...	0·03	0·01	—	—	0·03	—	—
18 ...	—	0·16	—	0·03	—	—	—
19 ...	0·16	0·97	—	0·24	0·33	—	—
20 ...	0·01	0·11	0·19	—	—	—	—
21 ...	0·03	—	—	—	—	—	—
22 ...	1·14	1·01	0·04	0·01	—	—	—
23 ...	0·34	0·30	0·59	—	—	—	—
24 ...	0·09	—	0·18	—	—	—	—
25 ...	Tr.	0·01	0·10	—	—	—	—
26 ...	0·47	0·02	0·02	—	0·01	—	—
27 ...	—	—	—	—	—	—	—
28 ...	—	1·22	—	—	0·01	—	—
29 ...	0·14	0·30	0·21	—	0·65	—	—
30 ...	—	—	—	—	—	—	—
31 ...	—	—	—	—	0·11	—	—
Totals ...	3·11	11·65	4·77	2·83	1·89	0·09	0·04

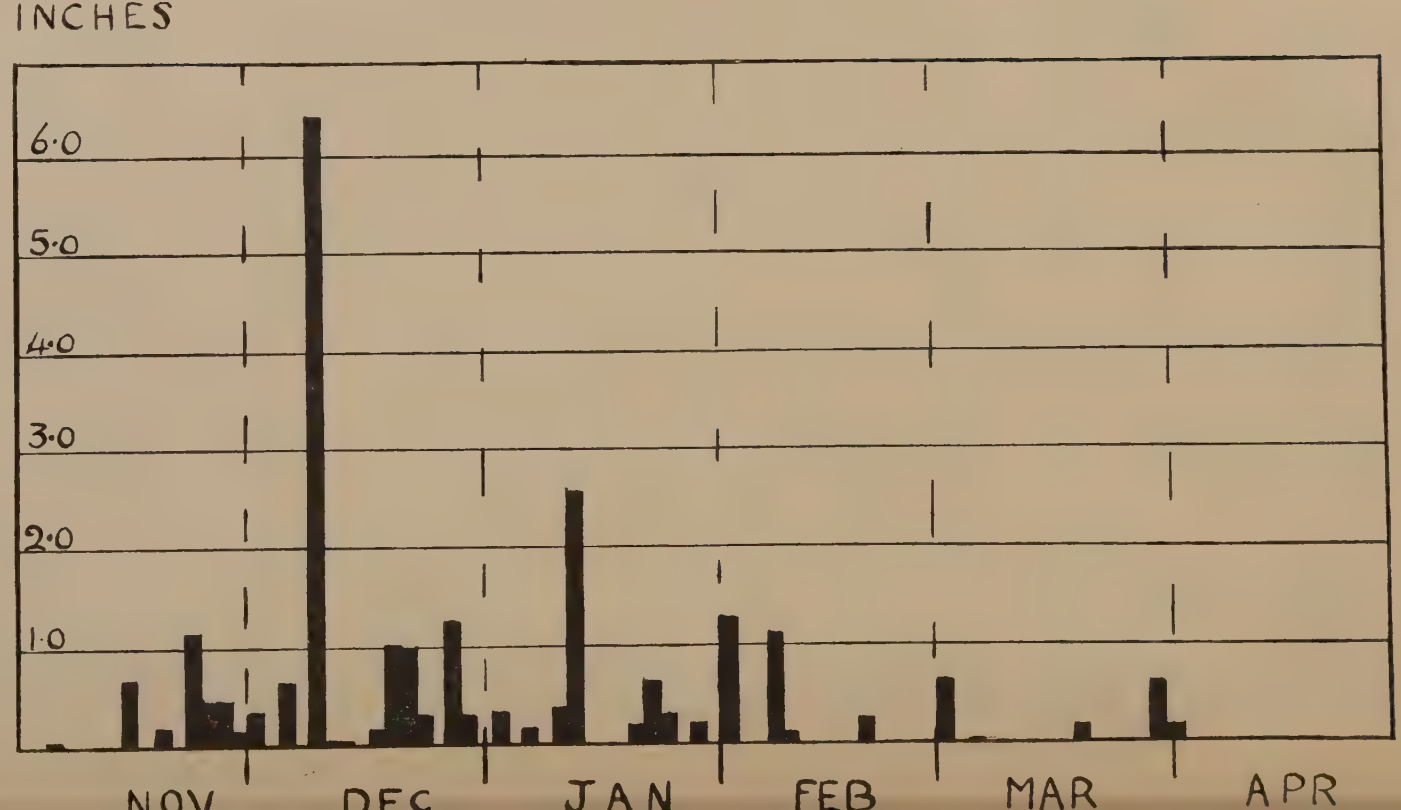
Total Rainfall for Season — 24·38 inches.

No rain recorded June–October inclusive.


REVERSE GRAPH TO READ SUNSHINE.
MAZABUKA
SUNSHINE, HUMIDITY & TEMPERATURE CHARTS, 1930-31
WEEKLY MEANS
SUNSHINE
HUMIDITY
MAXIMA
TEMPERATURE
MINIMA
NOV
DEC
JAN
FEB
MAR
APL
MAY
JUN

RAINFALL - MAZABUKA, 1930-31

IN 2-DAY TOTALS



ANGLO-EGYPTIAN SUDAN

REPORT ON THE WORK ON COTTON CARRIED OUT BY THE PLANT BREEDING SECTION, DEPARTMENT OF AGRICULTURE AND FORESTS, SEASON 1930-31*

BY

M. A. BAILEY.

Part I.—Summary.

The general yield at the Experimental Farm at Shambat has been disappointing, though better than that obtained in the Gezira. For Egyptian and related cottons the yield came out at about 630 rottles† of seed-cotton per feddan,‡ and for American cottons at about 950 rottles per feddan. The lowness of yield is to some extent attributable to Leaf Curl disease, but it seems clear that some other undetermined factor was the main cause (p. 99).

The season was remarkable for the absence of cold weather and for the high day-temperatures experienced. This is in marked contrast with the previous season, when excellent yields were obtained (p. 99).

The flowering curve of the Observation plot started to rise normally, but never rose to its expected height and tailed off gradually at a low level. This initial failure, due presumably to bud shedding, was followed later by a very high rate of boll shedding (p. 100).

In the American cotton breeding plot, certain selections from S.G.85 (supplied by the Cotton Breeding Station at Serere, in Uganda) and from Parnell's U.4, as well as 8 selections made locally from Delrect, Columbia and Meade gave promising results (pp. 101 and 102).

In the Egyptian and Sea Island breeding plots interest has centred chiefly around the production of types resistant to Leaf Curl. Out of 106 families grown, 9 were entirely free from disease and 15 were highly resistant (pp. 102 and 103). It is clear that there is every probability that this disease can be controlled by the breeding of resistant types, and propagation of the more likely strains already produced is being pushed forward without delay. An interesting case of " self-pruning " by tip-abortion is noted (p. 103) and in another

* May 1st, 1930, to April 30th, 1931.

† A "*rottle*" is a measure of weight almost exactly equivalent to a *pound*.

‡ A "*feddan*" is a measure of area almost exactly equivalent to an *acre*.

strain the plants have been found to show a tendency to enforced self-pollination owing to the only partial opening of the flowers (p. 103).

Arrangements were made for all the more important new strains growing at Shambat to be tested at the Research Farm at Wad Medani for resistance to Leaf Curl and Blackarm (p. 104). The results have been extremely valuable, and in the coming season this side of the work will be greatly extended.

A stage has now been reached when the propagation of a large number of new strains has to be undertaken. Details are given (pp. 104 to 108), together with certain information extracted from the reports supplied by the Graders on the quality of these new types. X.A.129 and X.A.2529 are two American types which have shown sufficient promise to warrant their inclusion in full-scale variety tests in the coming season. X.A.02629, a selection from Columbia, has not yet reached this stage but is considered likely to be superior to X.A.2529.

Delrect was propagated on a large scale at Mikeilab and gave a satisfactory yield (p. 106).

Three fixed Sakel-Sea Island hybrids are being propagated. Two of these, XH1029 and XH1229, are highly resistant to Leaf Curl and are considered to be possible alternatives to the susceptible Sakel cotton at present grown in the Gezira (p. 107).

Shambur Sakel IV, which received its first full scale test last year, is being propagated-on in view of its resistance to Leaf Curl and the excellent yield results obtained in the Shambat variety test. An important feature is that this variety does not shed its cotton, thus reducing very materially the time and labour spent in picking (p. 107).

The propagation of Sakel 186 has been suspended, as this variety is no more resistant to Leaf Curl than ordinary Sakel (p. 107).

A full report on the results of Variety tests will be found on pages 108 to 130.

The " Egyptian Line Test " at Shambat included several new types from Egypt as well as a considerable number of new strains. Nine of the varieties tried gave indications of being higher yielders than Sakel and several were highly resistant to Leaf Curl (pp. 109-111).

Giza 7 was found to be specially susceptible both to this disease and to Blackarm.

The incidence of Leaf Curl in this plot was very irregular and attempts were made to correlate this with soil character, but without success (page 112).

In the Standard Egyptian Variety tests carried out at Wad Medani, Barakat and Shambat, the most important features were the continued success of Sakel 186 in the Gezira and the relative immunity

to Leaf Curl shown by Shambur Sakel IV, as well as the yield given by the latter at Shambat (pp. 112, 113 and 115).

The "American Line Test" was chiefly devoted to the trial of new selections made at Shambat and four of these gave very promising results (p. 118).

The Standard American Variety tests included eight plots, located in pairs in the most important centres in the Sudan. The same varieties were grown at each station and the results compared. The yield results (based on *lint* weights) are given on page 126, and the degree of significance of the observed differences between varietal yields are indicated by circle diagrams on page 127.

The most important deductions to be made are the outstanding success of Parnell's U.4 in Mongalla and the Nuba Mountains—a success due in no small measure to the high ginning out-turn of this variety. The new Shambat selection, XA2728, gave the best results in the Gedaref district, and Pump Scheme strain retains its supremacy in the district north of Khartoum. On the basis of valuations received from the Graders in England an attempt is made to estimate the gross cash return given by the different varieties tried (p. 129).

Graders' reports for the 1930/31 crop have been received in time for inclusion in this report, so that in the present case we have the results of two seasons before us. The available information on the Shambur Sakel Group is summarized (page 131), as well as that relating to the new Sakel-Sea Island hybrids (p. 132).

Comparative valuations for Delrect, Webber 49, XA2728, Parnell's U.4 and Pump Scheme Strain are tabulated on pages 132 and 133. "Delrect" definitely takes first place, on a valuation basis, but as shown elsewhere in this report the extra premium obtained is not sufficient to enable it to compete with such high yielding types as Parnell's U.4.

Spinning test results on the 1929/30 crop are reviewed (pp. 134–135). It is satisfactory to find that Shambur Sakel I did not give appreciably more waste than other Sakels against which it was spun. In American cottons a sample of "Delrect" from Bueda gave the best all-round performance of all the samples of American cotton submitted (25 in all) (p. 135).

"Measurable character" determinations are summarized on pages 135 and 137, samples from Talodi giving the most satisfactory results.

It has been noted that both Egyptian and American cottons grown in the Sudan are frequently dark in colour. This is particularly noticeable in the case of samples kept at Shambat. Certain preliminary investigations as to the cause of this "browning" have been made (p. 137) which indicate that under certain circumstances both high

temperatures and high humidity can produce effects similar to those under consideration.

The Section co-operated again with the Inspectorate staff of the Department of Agriculture and Forests in carrying out certain preliminary experiments in the Southern Sudan (pp. 138 to 147). The programme this year was considerably wider than that of the previous season.

A " Dates of Sowing " experiment carried out at Torit, Kirrippi and Meridi confirmed last year's results and points emphatically to sowing in early June, as soon as the rains have really set in (pp. 139 and 140).

Manurial experiments at Talodi and Meridi showed only slight increases with added nitrogen, potash or phosphate (p. 142). A similar experiment at Kagelu (in the Yei River district) showed an increase of 33% with " complete " manure and may indicate a general deficiency of available nitrogen and minerals (p. 143), but reasons are given for considering that this deficiency is not the only factor of importance acting adversely in that district.

Experiments on artificial defoliation of cotton plants, carried out at Talodi and Meridi indicate that the practically complete defoliation of plants, such as might be produced by an extremely severe attack of Angular Leaf Spot, produces a check in the growth of the plants from which they are unable to recover (pp. 144 to 146).

An experiment on soil replacement at Kagelu appears to demonstrate clearly that the nature of the subsoil is not the key to the poor cropping of cotton in that area (p. 146).

A further experiment at the same place appears to show that insect pests are not primarily responsible for low yield (p. 146).

A very tentative test was made at Kagelu of various widely distinct types of cotton. The only one of these which showed promise was the Nigerian variety " Ishan," which appeared to shed much less than the other kinds (p. 147). Further experiments with this kind are being made in the coming season.

Part II.—Introductory.

Staff.

Mr. L. A. Palmer reported on March 2nd, on his attachment to the Section for the purpose of taking over the duties of Farm Superintendent from Mr. T. Cartwright, who retired in August, 1931.

Experimental Farm.

Cotton	19½	feddans.
Dura, Maize and Dukhn	2½	,,
Berseem	5½	,,
Lubia and other beans	14½	,,
Pigeon Pea	1	,,
Castors	1	,,
Wheat	1	,,
Simsim	½	,,
Miscellaneous	½	,,
Fallow	31	,,
Trees, etc.	18½	,,
Citrus plantation	1½	,,
	97	feddans.

Arrangements are being made to take in an area of 5½ feddans, formerly handed over to the Forestry Section, in order to provide additional ground for the early stages of propagation of new types of cotton.

The inclusion of a crop of Berseem in the regular rotation for the breeding plots has been discontinued in the present year, owing to the great difficulty experienced in obtaining a satisfactory tilth for the cotton crop after the prolonged waterings given to the Berseem. In its place, Lubia has been introduced into the rotation in order to provide fodder for the working cattle and for soil improvement.

As in previous years a variety test plot of 5 feddans on the Shambat Pump Scheme was worked by the staff of the Research Farm. This is not included in the statement of areas given above.

Arrangements have been made for an extension of 45 feddans, which will also be run by the farm staff, and ploughing and preparation of a part of this ground has begun.

This will be employed for a Roguing Plot for Egyptian-type cottons (15 feddans under cotton each year). Up to the present year reliance has been placed on native cultivators for this purpose, but the low standard of cultivation and general apathy of the cultivators have resulted in such low yields that it has been found to be no longer possible to continue on this basis without seriously retarding progress in the early stages of propagation of new varieties.

General.

The general yield of cotton for the whole farm area has been disappointing after the very promising appearance of the crop at the mid-season stage.

Conditions at sowing time were decidedly unfavourable, large areas being waterlogged either shortly before or shortly after sowing.

Blackarm was bad in the earliest stages in some parts of the farm and a propagation area of Sakel 186 was practically killed out and had to be largely resown in consequence.

The rainfall for the season was abnormally high, amounting to 248 millimetres, practically all of which fell between August 5th and September 5th (the "normal" for Shambat is 113 millimetres only); 86 millimetres fell on a single day (August 25th), causing extensive flooding.

In the previous year (1929) the total rainfall at Shambat was even higher (257 millimetres), but in that year the bulk of the rain fell a whole month earlier and well before the main sowing period.

In the present season the early growth of the plants, except in certain isolated cases, was satisfactory once they had recovered from their initial difficulties.

All plants which had not actually been killed out by Blackarm, rapidly threw off the disease on the cessation of the rains and the final effect on the general crop must have been very slight.

It is unfortunate that the two plots which gave the poorest results were the two breeding plots—"Egyptian-type" and "American type." The former suffered particularly from flooding in the early stages and this, combined with the bad tilth consequent on the growing of a crop of Berseem on the land previously, gave the plants a particularly bad start. It is very difficult, on the other hand, to find any possible reason for the comparative failure of the American Plot. It was sited on good, permeable soil and was sown on a date which previous experience had shown to give very satisfactory results (end of August). The plants, however, were stunted from the start and grew feebly throughout—the final yield being only about one-third of that obtained from a similar and adjacent plot sown at just about the same time in 1929.

What is much more remarkable, however, is that a portion of this same field which had been sown about 4 weeks earlier produced vigorous free-growing plants which never at any time showed signs of being checked in their growth. The difference cannot be ascribed to Blackarm which did no appreciable damage to any of these plants. It would seem certain that it must be attributed to some undetermined effect of the rain which had fallen in the interval between the two sowings. It is estimated that the difference in yield between the two portions of this plot amounted to over 100%.

Reverting to the farm as a whole, growth during December and January was satisfactory and it was hoped that all leeway would be made up and that the final crop would be not far off that of the

RFS Shambat – Temperature Graph

Season 1930-31.

(3-day means)

	JULY		AUGUST		SEPTEMBER		OCTOBER		NOVEMBER		DECEMBER		JANUARY		FEBRUARY		MARCH		APRIL		MAY		JUNE	
Actual Max. during half Month	41	41	40·8	40	40·8	43·7	42·4	42·2	39·0	37·2	34·8	40·8	38·3	38·0	38·2	38·0	38·5	42·8	45·0	45·5	45·6	46·0	45·5	45·0
Days of 40°& over	2	3	1	1	1	9	15	8	—	—	—	—	—	—	—	—	—	10	9	15	11	14	12	15
Actual Min. 10 during half Month	22	23	20·8	19·5	18·5	23·3	20·6	18·2	18·0	15·4	8·6	14·0	11·0	11·4	13·4	11·5	12·0	12·0	13·0	16·8	17·0	17·0	22·0	21·5
Days of 10°& under	—	—	—	—	—	—	—	—	—	—	2	—	—	—	—	—	—	—	—	—	—	—	—	—

1930 1931

Rainfall 1930/31

July 19th. - 6 mms.
" 28th. - 2 "

Aug. 7th. 2 mms.
" 13 " - 4 "
" 15 " - 13 "
" 16 " - 12·3 "
" 18 " - 33·6 "
" 25 " - 86·5 "
" 28 " - 24·5 "

Sept. 1st. - 16·5 mms.
" 4th. - 30 "

previous year. This hope was, however, not fulfilled and the final yield for the farm came out at about 630 rottles per feddan (2 kantars) for Egyptian and related cottons, and at about 950 rottles per feddan (3 kantars) for American.

These yields were only half those obtained in the previous year.

Leaf Curl appeared at about the end of September –the date of appearance being roughly the same as in the Gezira.

The disease spread fairly rapidly, but, as in previous years, was remarkably " patchy " in its distribution. This " patchiness " could not be correlated with any particular condition or property of the soil, though –with the help of the staff of the Chemical Section of the Wellcome Tropical Research Laboratories—a detailed investigation was made of this possibility.

On the whole, by the end of the season, the disease was much more widespread at Shambat than in previous seasons, though its severity on individual plants was not equal to that noted in 1928/29.

It cannot be doubted that the prevalence of Leaf Curl this year has had some effect in depressing the final yield at Shambat, but it is equally certain that plants apparently unaffected by Leaf Curl also gave poor final yields. The general impression is gained once more that factors other than Blackarm and Leaf Curl are of primary importance at Shambat.

The season, as a whole, was remarkable for the absence of cold weather. Day temperatures, almost invariably, were well above normal, as shown on the accompanying chart.

The contrast with last season, which was decidedly cold from December onwards, should be noted in view of the fact that the general yield last year at Shambat was exceptionally good.

Sudan bollworm did very considerable damage to some of the earlier sown lots of cotton. A light trap was used and very large numbers of moths were taken at the start of the season. Later on the Sudan bollworm ceased to be important. The Egyptian bollworm was never present in great quantity, but Pink bollworm undoubtedly did a lot of damage at the end of the season, though counts of green bolls affected in April (end of season) did not give exceptionally high figures.

Locusts, this year, were practically entirely absent from Shambat.

The ginning out-turn for Egyptian and Sea Island cottons grown at Shambat was about normal –in contrast to the very low figures obtained in the Gezira this year—but American types seemed to be rather " down " in this respect.

The Shambat observation plot, in common with the rest of the farm, gave a poor yield this year. This was foreshadowed by the flowering curve, which, though it started to rise more or less normally, never reached one-half of the height of last year's curve. The curve was without any well-marked peak and fell off slowly and gradually after passing its maximum. The maximum flower production rate was of the same order as that observed in 1928/29 (a particularly bad year), but the marked drop noted in that year as following immediately after the maximum period, is only feebly reflected in the present year's records.

All observations then go to show that the poor yield this year was due in the first place to some factor which adversely affected flower production in October and November. Our records indicate that the deficit in crop due to suppression or shedding of flower buds was later still further increased by exceptionally heavy boll-shedding.

In the " Breeding Plots " and " Selfing Propagation Plots " this year no less than 35,000 flowers were shed in the earliest stages of maturation, out of a total of 67,000 flowers selfed (i.e. 52%).

Further sheddings occurred during the later stages of boll maturation and the final figures obtained from the " Selfing Propagation Plots " at Shambat show that only 41% of flowers which opened succeeded in ripening pickable cotton.

Boll-shedding was much more pronounced in the case of bolls produced from flowers opening during and after December, than in the case of flowers opening in September, October and November.

Part III.—Experimental Work, etc.

1. Inspection of Cotton Areas.

Visits were made by the staff to the Gezira Research Farm, the Sudan Plantations Syndicate's Seed Farm and to other parts of the Gezira.

Mr. King carried out a tour of inspection of experimental plots in the Nuba Mountains district and in Mongalla.

2. Selection, Line-Breeding and Hybridization.

Work has continued along lines which are now fully standardized (cf. Reports for 1925/26 and 1926/27 for details).

The following is a list of the families grown and selections which have been made from them (cf. 1929/30 Report for explanation of abbreviations).

	Number of families grown in 1930/31.	*Number of plants selected for growing on next year.*
American N.S. Plot	31	17 { 15 for P.S.S. 2 for P.L's
American P.L. Plot	29	27 { 26 for P.L's 1 for P.S.S.
American Hybrids	2	4
Egyptian and Sea Island N.S's... ...	74	32 { 25 for P.S.S. 7 for P.L's
Egyptian and Sea Island P.L's... ...	32	44 (for P.L's)
Hybrid Plot	46	48
Reference Plot	50	50 (Estimated)
TOTALS	264	222

In addition to the plants shown above, as selected for growing-on in 1931, there will be 3 other " American " selections and about a dozen " Egyptian " selections from outside sources.

" Selfing " work was carried out in the above plots and in the " Selfing Propagation Plots " according to the system described in the Report for 1927/28.

A total of 67,000 selfed flowers was reached during the season, the average number of boys employed on this work being eleven.

The families most worthy of mention in the *American " New Selection " Breeding Plot* were two selections made from " S.G.85 " (received from Mr. Nye, Cotton Botanist, Uganda) and two selections made from " Parnell's U.4 " in Uganda.

These families were easily the most vigorous and fruitful in the " New Selection Plot."

Of the former type, Mr. Nye states that this strain gave results (in Uganda) similar to but better than Parnell's U.4 and that it showed considerable resistance to Blackarm.

The families grown here were still splitting, but the lints were for the most part rather harsh and rather short. An unexpected feature is the lowness of the ginning out-turn (mostly round about 27%), in view of the very high G.O.T. of the parent plants.

The selections grown from U.4 also proved to be far from pure; but the lint in some cases was of good quality and the G.O.T. was usually satisfactory. In view of the promising behaviour of U.4 in the Southern Sudan, special attention will be given to these derived types.

In the *American Pure Line Plot* the " vigour strain " of Delrect, referred to in last year's report, has again shown up as being greener,

stronger-growing and more fruitful than other strains of this type. Arrangements are being made for the strain to take the place of those previously issued, if yield trials in the coming season are satisfactory. The selections from Columbia, also referred to in that report, have again in most cases stood out as high-yielders, especially those derived from A.O.26 29 which itself gave excellent results in the "Linc Test" this year.

The only drawback to these strains is a tendency to lowness in ginning out-turn, but selection is being directed towards improvement in this particular.

This applies even more to the pure line families representing another selected strain of Columbia, X.A.2728, which is disappointing in view of the encouraging results for yield and lint quality obtained with this new type in tests in the Gederef district.

One of the most promising families in this plot was A.6/30—a re-selection from a derivative of Meade cotton. The original selection gave evidence of being extremely fruitful and early, but the lint quality left much to be desired. The present re-selection appears to be equally fruitful and early, but has much improved lint of about $1\frac{3}{16}''$. This new strain will receive its first comparative yield test in the coming season and is expected to prove a useful type—it differs markedly from the original Meade, both in its relative shortness of fibre and in its relatively high ginning out-turn.

In the *Egyptian and Sea Island Breeding Plots* interest has centred most particularly on the question of resistance to Leaf Curl. Out of 106 families examined in detail (including in this case the Hybrid families), 9 were entirely free from disease and 15 showed only a few affected plants (with relatively slight symptoms).

Owing to the very slight and patchy incidence of the disease in the *previous* season (1929/30), it has not been possible to follow out the question of inheritance of disease resistance. Certain cases have been noted, however, of plants definitely recorded as having been diseased which have given rise to families in which the majority of individuals are immune or highly resistant. No case has as yet been met where a highly resistant plant has given rise to highly susceptible progeny.

In the present season, seed has been obtained from a cross between a plant, itself susceptible and derived from a family known to be 100% susceptible, and another plant itself free from disease and derived from a family recorded as 100% immune. This cross will form the basis of future investigations on the mode of inheritance of susceptibility to Leaf Curl.

Two families were of particular interest in the *Egyptian and Sea Island New Selection Plot* in that the large majority of plants in them showed abortion of the apical bud at a fairly early stage. In one family the percentage of plants thus affected was 65 and in the other 80%.

None of the other families in the same plot showed more than very occasional tip-abortion. These two families were from sister plants, and it is clearly an inherited characteristic of an unusual type. The plants which had thus been " self-pruned " grew strongly and yielded well.

Another interesting family in the same plot was grown from a parent plant on which the flowers rarely opened completely, thus affording almost complete natural protection from cross-fertilization. A certain number of the offspring showed the same trait, but in varying degrees. Apart from this peculiarity, the family as a whole was undesirable, the plants being weak and much attacked by Leaf Curl. The importance of this character of self-protection is, however, obvious and efforts will be made in the coming season to obtain a strain pure for this characteristic.

In the *Egyptian and Sea Island Pedigree Line Plot*, there occurred one family (ex-Sakel) which appeared to be entirely immune from Leaf Curl and another family (ex Afifi) which showed 100% infection. Lint from the former family has been examined by the Graders and is reported on as being " Light brown, $1\frac{1}{2}''$, rather wasty, strong, fairly lustrous and fine." It was priced at 8.01d. against July futures at 7.26d.

One of our long-linted selections from Afifi and two of the strains received from Mr. Lambert, referred to on page 211 of last year's report, have again done very well, all three being found to be highly resistant to Leaf Curl. These and the other immune family mentioned above will be pushed ahead as rapidly as possible, provided that further yield tests give satisfactory results.

Samples of these three lots have also been submitted to the Graders at home, who report as follows :—

X730 (Longlinted ex. Afifi.). $1\frac{1}{4}'' - 1\frac{3}{8}''$. Medium strong ; light brown ; rather wanting in fineness and lustre. 7·51d.

X1530 {ex. Lambert's / B.A.R. Selection} $1\frac{1}{4}'' - 1\frac{5}{16}''$. Medium to strong ; brown ; rather wanting in lustre and fineness. 7·51d.

X1730 {ex. Lambert's / B.A.R. Selection} $1\frac{1}{4}''$. Medium strong ; brown ; wanting in lustre and fineness. 7·26d.

July futures on same date = 7.26d..

In the *Hybrid Plot* a wide range of types was obtained from crosses previously made between Sea Island and Uppers, Sea Island and Afifi

and Sea Island and Tanguis. Progress has been made towards the isolation and fixation of desirable types from these.

The derivatives from an earlier Sakel-Sea Island cross, which have now reached the F.8 stage, were for the most part rather disappointing especially in the matter of ginning out-turn, but three strains from this source with satisfactory yielding power and all more or less highly resistant to Leaf Curl have now been purified sufficiently for bulk propagation, and one of these appears to be satisfactory also in the matter of ginning out-turn.

During the season under review arrangements were made with the Chief Inspector, Gezira Research Farm, for the growing of short lines of cotton representing the more important of the new strains grown this year in the breeding plots at Shambat. Forty-two new types were tried in this manner at the Gezira Research Farm, the work being superintended by Mr. A. R. Lambert who kindly supplied us with a report on the general behaviour of the plants, especially as regards resistance to Blackarm and Leaf Curl.

The results have been of the greatest assistance to the work at Shambat, and in the coming season this work will be greatly extended.

As regards Leaf Curl resistance, the results obtained at Medani confirmed in general the observations made at Shambat at about the same time of year, but certain differences did occur in some cases, due presumably to splitting.

3. Propagation.

The system employed and terms used have been explained in the Report for 1929/30.

The following is a list of the types propagated during the present season :—

(*a*) American Cottons.

"*Selfing Propagation Plots*"—

X.A. 02629
X.A. 02829
X.A. 129
X.A. 1129
X.A. 2529
X.A. 2829
Delrect II.
Uganda S.G. 27
Uganda S.G. 29
Parnell's U.44.2

Area roughly $\frac{1}{20}$ feddan each.

Isolated Propagation Area—

Wild's No. 1 (area $\frac{1}{2}$ feddan).

"*S.F.T.*" *Plots*—

X.A. 129 (area about $\frac{3}{4}$ feddan).
X.A. 1129 „ „
X.A. 2529 „ „

Roguing Plot—

Nucleus area ... Delrect II. ($\frac{1}{2}$ feddan)
Main area ... Delrect I. ($19\frac{1}{2}$ feddans)

Increase Area (surrounding Roguing Plot)—

Delrect I. (580 feddans)

(*b*) Egyptian and Related Cottons.

"*Selfing Propagation Plots*"—

Sakha 6
Sakha 11
Sakha 4
Giza 7
Heaton 39.12 (2)
X.H. 529
X.H. 1229
} (Areas varied from $\frac{1}{50}$ to $\frac{1}{25}$ feddan aprox.)

"*S.F.T. Plots*"—

X.H. 529 (area $\frac{1}{8}$ feddan).
X.H. 1029 „ $\frac{1}{4}$ „
X.H. 1229 „ $\frac{1}{5}$ feddans

Bulk Propagation Plot—

Shambur Sakel IV. (area 3 feddans)

Nucleus Roguing Plot and Belt—

Sakel 186/24 { Nucleus plot $\frac{3}{4}$ feddan.
Belt area 4 „

Main Roguing Plot—

Sakel 186/24 (area 15 feddans).

Increase Area (surrounding Roguing Plot)—

Sakel 186/24 { Inner Zone ... 81 feddans.
Outer Zone ... 48 „

It is impossible to do more than make the briefest comments on some of the above types.

Most of the kinds grown in the American selfing propagation plots were also grown in the American Line Test and their behaviour is described in that portion of this report. The three most successful judged by yield appear to be X.A.129, X.A.02629 and X.A.1129.

X.A.02629 is a selection from Columbia and is considered to be one of the best American selections made at Shambat. It is being propagated up in the coming season in order to obtain seed for testing throughout the country. It is extremely early and has lint of about $1\frac{1}{4}''$ staple of excellent quality but tends to be rather low in ginning out-turn.

X.A.129 is a selection from Pump Scheme, and X.A.1129 a selection from Meade.

X.A.129 is rather short in fibre (not much more than $1\frac{1}{8}''$) but is good saleable cotton. Under irrigated conditions it appears to be the heaviest yielder which we possess.

X.A.1129 is also a heavy yielder and early, and is a very attractive-looking plant. In quality it is, however, a bit rough and harsh. A further selection has been made from it which appears to combine good quality with the other characteristics of this strain. Though

originally selected from Meade this is quite a distinct type, being not more than $1\frac{1}{8}''$ staple and having a relatively high ginning out-turn.

X.A.129 will be tested during the coming season at 4 stations in the Rain Area (Nuba Mountains and Mongalla). X.A.1129 will be tested at two stations in the Nuba Mountains district.

X.A.2529, which appears along with the above two types in the S.F.T. plots, is another selection from Columbia which has shown promise. This type also will be tested out during the coming season in Mongalla and in the Nuba Mountains district.

Graders' opinions on the above types grown in 1930/31 have been received and are summarised below :—

X.A. 02629 (grown at Shambat). S.G. Middling. $1\frac{3}{16}'' - 1\frac{1}{4}''$; medium to strong; rather wanting in fineness and lustre. 6·96d.

X.A. 129 (grown at Shendi). Barely S.G. Middling. Good $1\frac{1}{8}''$; strong; rather wanting in lustre and fineness. 5·96d.

X.A. 1129 (grown at Shendi). Strict G. Middling. $1\frac{3}{16}'' - 1\frac{1}{4}''$; strong; lustrous and fine. 7·21d.

X.A. 2529 (grown at Shendi). Strict G. Middling. $1\frac{1}{4}''$; strong; rather wanting in fineness and lustre. 6·46d.

July American futures on the same day stood at 4·96d.

The Roguing Plot of Delrect at Mikeilab was successful despite a certain amount of damage from locusts in the early stages and very heavy damage from bollworm at the end of the season. The yield of seed cotton obtained from the Nucleus Roguing Plot was $5\frac{1}{2}$ kantars per feddan (about 1,700 pounds per acre), whilst that from the main area was $3\frac{1}{2}$ kantars (about 1,100 pounds per acre). The Graders' report on a sample of Delrect II from the Nucleus Plot was as follows :— "Barely Strict G. Middling, $1\frac{3}{16}''$, rather mixed with short, strong, lustrous and fine 6.71d. (July futures 4.96d.)." Propagation will be continued during the coming season at another Pump Station on the Nile (Bouga), and it is understood that the seed from the "Increase Area" at Mikeilab will be distributed by the Department of Agriculture and Forests for sowing in the Eastern Jebel district of the Nuba Mountains. About 90 tons of seed will be available for this purpose.

Turning to the propagation plots for "Egyptian and Related Cottons," the most interesting types are the three which appear in the list given above under the heading "S.F.T. plots."

All three types are fixed hybrids between Sakel and Sea Island cottons.

A small sample of X.H.529, grown at Shambat in 1929, was stated by the Graders to be exceptionally fine cotton, superior to the best Kassala Sakel, but this year's sample, though satisfactory, did not receive an equally good report. The plants are strong and vigorous,

but are, unfortunately, highly susceptible to Leaf Curl. Efforts are being made both by bulk selection and by re-selection of single plants to obtain a substrain which will be resistant to this disease.

Both the other two types, X.H.1029 and X.H. 1229, are highly resistant to Leaf Curl and will receive their first field scale trial in the coming year in the Preliminary Variety Test at Shambat. They will also be grown in Line Tests at the Gezira Research Farm, and propagation will be pushed on rapidly without awaiting the results of those tests.

If either of these types should prove suitable for general growth in the Gezira, it is estimated that sufficient seed could be produced in the course of 5 or 6 years to fill the whole area.

Graders' opinions on 1930/31 samples of the above are summarised below :—

X.H. 529 (grown at Shambat). Good. $1\frac{3}{4}''$, irregular; light colour; medium strong; moderately fine and lustrous. 8·51d.

X.H. 1029 (grown at Shambat). Good. $1\frac{3}{8}'' - 1\frac{5}{8}''$, irregular; light colour; medium strong; wanting in fineness and lustre. 8·01d.

X.H. 1229 (grown at Shambat). Good. $1\frac{3}{4}''$, irregular; light colour; very strong in places; moderately lustrous and fine. 8·76d.

July futures on same date = 7.26d.

Shambur Sakel IV is another type which has been found to be very resistant to Leaf Curl Disease. It is also somewhat resistant to Blackarm. It is longer and finer than ordinary Sakel and should form a satisfactory substitute as regards lint. It received its first serious trial in the Gezira last season and grew well, producing a large crop of bolls. A considerable proportion of these, however, failed to open properly and the final yield was disappointing. Further extended trials will be made in the coming year, and, in view of its comparative immunity from Leaf Curl, a propagation area of 60 feddans will be planted in the Gezira.

A point of some importance in connection with this variety is its ability to " hold " its cotton in the bolls after the latter have opened.

Sakel cotton, on the other hand, has to be picked at fortnightly intervals throughout the season in order to prevent the cotton falling on to the ground, and, even so, a certain amount of loss occurs.

A portion of the propagation plot of Shambur Sakel IV grown at Shambat this year, was left unpicked for the purpose of ascertaining how long the cotton would remain in the bolls before dropping or being blown out. After $2\frac{1}{4}$ months no more had dropped than is normally the case with Sakel cotton when left for two weeks. This property might be of great value in reducing, very materially, the time and labour spent on picking in this country.

The propagation of " Sakel 186," which was grown on the Shambat Pump Scheme in the present season, will temporarily be suspended in

view of the fact that it is no more resistant to Leaf Curl than ordinary Sakel. This is unfortunate in view of the fact that this type has again shown itself superior in yield to other types of Sakel when tried out in Variety Tests at Barakat and Wad Medani.

The propagation of Sakel 186 on native land at Shambat this year proved an almost complete failure, owing chiefly to the lack of any serious attempt on the part of the owners of the land to keep it clean and properly cultivated. The average yield of seed cotton for the whole area came out at less than half a kantar per feddan.

For the coming season arrangements have been made to take over an area of land for the purpose of a Roguing plot. This area will be farmed by the staff of the Plant Breeding Section by direct labour.

4. Cotton Variety Testing.

List of test plots :—

(A) Egyptian and Allied Types of Cotton.

I. *Line Test.*

At Shambat Research Farm.

II. *Standard Test Series* (*Irrigated*).

(i) Shambat Pumping Station.

(ii) Wad Medani (Gezira Research Farm) } Gezira

(iii) Barakat (Sudan Plantations Seed Farm) } tract

(B) American Types of Cotton.

I. *Line Test.*

At Shambat Research Farm.

II. *Standard Test Series.*

(i) Shendi (Karu soil)	Irrigated plots on a riverside Pump Scheme, north of Khartoum.
(ii) Moeis (new river-soil)	
(iii) Talodi	Nuba Mountains District (rain-grown)
(iv) Kadugli	
(v) Bueda	Gedaref District (rain-grown)
(vi) Fau	
(vii) Kirrippi	Mongalla (rain-grown)
(viii) Opari	

The general arrangements were almost exactly similar to those in the previous season, except that the technique for "Line Tests" has been very considerably developed, and the locality for the two test plots in Mongalla has been changed from the Yei district, where they were in 1929/30, to the Opari district in South-eastern Mongalla which appears to be a much more likely district for development.

The results from the variety tests ("Standard Series") are all given in weights of *ginned lint*, instead of in weights of seed-cotton, as the differences in ginning out-turn between varieties are often very considerable indeed.

The data from these standard tests have all been worked up by Fisher's analysis of variance method, making use of the "Z test" for estimation of significance of variance due to varieties and of the "t test" for estimation of significance between variety means.

The results of comparisons between varieties are shown diagrammatically, using circles as in previous years.

(A) *I.* Egyptian, etc., Line Test.

Single lines, 100 metres long, were grown between two lines of a standard variety (Sakel 186).

Twenty varieties were tested and, in addition, 3 lines of the "control" variety were grown between lines of the same kind, as a guide to the accuracy of the method.

The varieties tried included several new types obtained from Egypt, namely :—

Giza 2, Giza 3, Giza 7, Giza 9.
Sakha 3, Sakha 4, Sakha 6, Sakha 11.

The remaining types were, with one exception, selections or fixed hybrids from our own breeding plots.

The plot escaped any serious damage from Blackarm and the general growth and vigour was satisfactory. The yield of each variety was compared in every case with the average of the yield of the two rows of "standard" variety growing on either side of it. In order that the comparison might be as accurate as possible, steps were taken at an early stage of development to ensure that the number of holes containing plants were exactly the same in the "variety" line and in the two "control" lines forming each "triplet."

The yield results may be summed up as follows :—

(*a*) *Varieties apparently definitely inferior to standard Sakel :*—
Giza 9, Sakha 3, Sakha 6.

(*b*) *Varieties apparently similar in cropping power to standard Sakel :*
Giza 2, Sakha 4, Sakha 11, X.H.529, X.H.1229, X.H.2129 and X.01929.

(*c*) *Varieties apparently definitely superior in yielding power to standard Sakel :*—
X.04729 gave yield of 151%, compared with standard.
X.01629 ,, ,, 148% ,, ,, ,,
X.02829 ,, ,, 145% ,, ,, ,,

X.0829 gave yield of			140%	compared with standard.		
Giza 3	,,	,,	133%	,,	,,	,,
Giza 7	,,	,,	131%	,,	,,	,,
X.02929	,,	,,	131%	,,	,,	,,
X.01429	,,	,,	129%	,,	,,	,,
X.03229	,,	,,	126%	,,	,,	,,

The figures given refer in all the above cases to yields of seed-cotton. All these kinds gave indication of satisfactory ginning out-turns, except possibly X.04729 and X.01629 which were probably rather below the Sakel control in this respect. X.02829 and X.02929 both appear to give very high percentages of lint.

With the exception of Sakha 4, Sakha 6 and X.02829 and X.02929 all the types tried were found to produce their fruiting branches lower down than in the case of standard Sakel, but this advantage was offset by a slower node production rate. The four exceptions mentioned showed a delay of a couple of nodes in the position of the lowest fruiting branch, but on the other hand had a somewhat higher node production rate.

"Giza 2" was notably early in flowering, and X.02829 and X.02929 were decidedly late (about 2 weeks behind the standard), otherwise the behaviour of the kinds tried was normal in this respect.

The most satisfactory flowering curves were given by X.01629 and "Giza 7."

The new types introduced from Egypt gave without exception rather short and weak-looking plants under our conditions, and all the Sakha types lodged badly. Giza 7 was the most vigorous of these new Egyptian types, producing a short compact plant, which was very free flowering.

The most interesting results obtained from the plot were in relation to disease resistance. The types selected for trial from our breeding plots had in many cases been chosen for their relative immunity from Leaf Curl and the results showed most striking differences in this respect. A count of infected plants made in January showed differences between varieties ranging from 1% infection to 92% infection. The incidence of infection on the "control" rows was very uneven and patchy, but by suitably subdividing the field at the time of making the count it was found that the infection in the "variety rows" maintained very closely indeed its relative proportion to that in the control rows, so that the results may be taken as being quite reliable.

"Giza 7," the "long-stapled Upper Egyptian" type newly introduced from Egypt and X.01429 (a locally-made selection from Afifi) proved to be extremely susceptible to Leaf Curl, being decidedly more

affected than the standard Sakel. They were closely followed in this respect by X.01929 (a local selection from Sakel) and "Sakha 4."

Giza 7 and X.01429, despite this, both gave higher yields than the standard Sakel, so that their yielding power in the absence of the disease should be remarkably high. Giza 7, however, was also found to be particularly susceptible to Blackarm, a fact which would finally rule out any possibility of making use of this variety in the Gezira, though not a serious handicap at Shambat.

No less than ten of the varieties or strains tried showed a high degree of resistance to Leaf Curl. These were :—

Giza 2 Giza 3 Giza 9 X.H.1229	Almost completely immune (less than 5% of plants affected).
X.H.2129 X.0829 X.01629 X.02829 X.02929 X.04729	Highly resistant (less than 10% of plants affected, except in case of X.H.2129 which showed a 15% infection).

Giza 2 and Giza 9 both gave yields inferior to the standard Sakel used in the test ; Giza 3, however, gave a satisfactory yield, but though longer in staple than ordinary Ashmouni is well below Sakel standard. The remainder are all at about Sakel level as regards staple, and it will be noted that five of them are included in the list of types which gave yields definitely superior to that of the standard Sakel. X.01629 and X.0829 were both particularly satisfactory in this respect. The former is a locally made selection from Sakel and the latter a local selection made originally from Afifi, but with rather lustrous lint of nearly Sakel length and almost white. X.04729, a form selected from Sea Island, gave the highest yield in the whole plot, but this is somewhat offset by a rather low ginning out-turn and by the fact that the strain is not yet definitely fixed. A sample of lint from this was examined by the Graders and was stated to be "Light in colour, $1\frac{1}{2}'-1\frac{3}{4}''$, strong, moderately fine and lustrous. Barely "good" in grade. 8.76d." (July Sakel futures 7.26d.)

X.02829 and X.02929 are two selections originally made by Mr. Lambert, both of which appear to be very high yielders, though, as stated above, they are late croppers. Samples of these were priced by the Graders on the same day at 6.76d. and 7.01d. (fully good fair to barely good).

In view of the irregular distribution of Leaf Curl amongst the "control" lines in this field an intensive study was made of the local conditions, in which the Government Chemist kindly collaborated by carrying out a large number of soil samplings and analyses. Notes were made on growth, vigour, flowering, etc., and on the position of patches of high ground and water-logged areas.

The soil samples were examined for moisture percentage, specific gravity, *p*H., capillary rise, soluble salts, moisture equivalents, and also for "mechanical" composition. As a result, it is only possible to say that Leaf Curl tended to be worst where the vigour of the plants was greatest. No correlation could be observed between infection intensity and any of the other factors examined.

The fact that centres of infection sometimes tailed off very gradually in one direction but abruptly in another, and also that the presence of highly susceptible and highly infected varieties in parts of the field did not necessarily give rise to increased infection of the adjacent "control" rows does not, however, suggest that the irregular distribution of the disease can be attributed solely to irregularities in the incidence of White Fly, which is known to be the vector of the disease. It seems probable that other factors, so far undetermined, were the main controlling factor.

(A) *II.* Egyptian, etc., Varieties (Standard Series) (Irrigated).

(i) Shambat Pumping Station.
(ii) Wad Medani.
(iii) Barakat.

The layout was on the standard "strip" system with five varieties, repeated 5 times and grouped into five blocks. Area of each plot approximately 4 feddans.

The same five varieties were grown in each plot :—

Sakel 186.
Fouadi.
Shambur Sakel IV.
Bolland 19.3.
Gezira Main Crop (seed from Kassala 1929/30 Crop).

Of these, *Sakel* 186 appears in these tests for the fifth year in succession. In previous trials it has always given satisfactory yield results, having been four times first in order of yield at Barakat and twice first at Medani, never taking lower than second place. In the present season it once more gave the highest yields both at Medani

and Barakat. Steps had been taken to work up a considerable stock of seed of this variety and it should have been possible to sow upwards of a thousand feddans with this type in the coming season. The advent of Leaf Curl disease has unfortunately introduced a new factor of prime importance, and as this variety has shown itself to be no more resistant to this disease than ordinary Sakel, further propagation work will be held up in order to allow of greater concentration of effort on other strains which show promise of being more or less immune.

Fouadi is a new introduction from Egypt, on trial here for the first time. It is a short growing variety, slow in node production, but rather strikingly early. The susceptibility of this variety to Leaf Curl was found to be roughly of the same order as that of Sakel, and at all three localities it showed itself to be very highly susceptible indeed to Black-arm. At Medani and Barakat it was easily lowest in yield, and it may taken to be definitely unsuited to our conditions.

Shambur Sakel IV is a substrain, in a purer form, of the Shambur Sakel I which was tried out last season, and, like it, shows a very high degree of resistance to Leaf Curl. It is a short plant, rather slow growing, but neat and compact in habit. In the present season this variety stood out not only owing to its comparative freedom from Leaf Curl, but also by its general appearance of fruitfulness. It is disappointing, therefore, to record that only at Shambat did it head the list in yield of seed-cotton ; at Medani and Barakat it was placed third and fourth respectively. At the Shambat plot, where the average yield for all varieties was about 720 rottles per feddan, this variety beat all other varieties by over 150 rottles seed-cotton per feddan. This result is in itself surprising, as in previous trials in that district it had failed to compete with Sakel. At Shambat the variety was definitely on the early side compared with Sakel, but this appears not to have been the case in the Gezira.

The behaviour of this strain this year at Shambat, coupled with the high degree of resistance to Leaf Curl shown both there and at Medani and Barakat is sufficiently encouraging to warrant rapid multiplication of seed stocks, pending further trials, and this will be carried out both at Shambat and in the Gezira during the coming season.

Bolland 19.3 is a selected strain of Sakel, which was included in this year's tests owing to its having shown indications of a certain degree of resistance to Leaf Curl in the previous year. This was confirmed in the present season, but as the degree of immunity was only very slight and as the yield per feddan in no case equalled that given by Sakel 186, further propagation and testing of this strain will be discontinued.

All three plots were supplied with protective " belts ", and these belts were made use of to obtain indications as to the behaviour of certain other types.

The types grown were :—

Shambat	...Garofallou ...	(2 strips).
Wad Medani ...	Garofallou ..	(2 ,,)
	Shambur Sakel II	(1 ,,)
	Shambur Sakel III	(1 ,,)
	Shambur Sakel V	(1 ,,)
Barakat	...Garofallou ...	(2 ,,)

At none of these three places did Garofallou give any indication of being a better yielder than any of the types included in the plots, and as it was found to be highly susceptible to Leaf Curl this variety will be dropped.

The three other strains of Shambur-Sakel all showed about the same high degree of resistance to Leaf Curl as that shown by Shambur Sakel IV, but did not give any indication of higher yielding power.

The following details for the three plots may be given :—

	Shambat.	*Medani.*	*Barakat.*
Soil	Medium loam.	Normal Gezira soil.	Normal Gezira soil.
Sowing	August 6th	August 22nd and 31st	August 22nd and 27th
Thinning	October 3rd and 19th	October 6th and 23rd	October 6th
Sulphate of Amonia	300 rottles (Oct. 5th)	—	—
Germination ...	Good	Rather irregular	Quite fair
Final Stand ...	Good	Irregular	Quite fair
Blackarm	Severe in earliest stages (August). Afterwards nil.	Relatively slight at start. Medium severe later.	Very slight until mid-October. Later severe.
Leaf Curl	First noted Sept. 30th, gradually increased in severity. At end of season, general but patchy. About 45% of plants of susceptible varieties were infected.	Started in early October. Spread rapidly. At end of Feb. susceptible varieties showed 99% infection.	Started end Sept. Spread rapidly, and final infection similar to Medani plot.
Growth	Mod. strong ; leggy.	Poor and weak.	Quite fair.

The results from these tests are summarized in the Table which follows :—

YIELDS OF SEED-COTTON AND LINT AND GINNING OUT-TURNS IN EGYPTIAN, ETC., VARIETY TESTS.

Variety or Strain.	Shambat. Average Net Yield of Seed-Cotton per feddan = 720 rottles.							Medani. Average Net Yield of Seed-Cotton per feddan = 380 rottles.						Barakat. Average Net Yield of Seed-Cotton per feddan = 850 rottles.					
	Seed-Cotton Yield per Bed (rottles).	Order of Yield for Seed-Cotton.	Ginning out-turn (per cent).	Lint Yield per Bed (rottles).	Order of Yield for Lint.	Probable correction to Yield of Lint (rottles).		Seed-Cotton Yield per Bed (rottles).	Order of Yield for Seed-Cotton.	Based on figures for G.O.T. obtained at Shambat.				Seed-Cotton Yield per Bed (rottles).	Order of Yield for Seed-Cotton.	Based on figures for G.O.T. obtained at Shambat.			
										Lint Yield per Bed (rottles).	Order of Yield for Lint.	Probable correction to Yield of Lint.				Lint Yield per Bed (rottles).	Order of Yield for Lint.	Probable correction to Yield of Lint.	
						Add	Subtract					Add	Subtract					Add	Subtract
Sakel 186 ...	89·8	3	28·4	25·5	3	—	0·7	51·9	1	14·6	1	—	0·3	118·6	1	33·3	1	—	—
Fouadi ...	85·9	4	29·1	25·0	4	0·1	—	39·7	5	11·5	5	—	0·1	80·6	5	23·6	5	—	0·4
Shambur-Sakel IV ...	109·6	1	26·4	29·1	1	—	—	48·1	3	12·8	4	0·5	—	104·8	4	28·2	4	0·4	—
Sakel Bolland 19·3	81·3	5	27·3	22·1	5	—	0·1	51·2	2	13·9	2	—	0·4	116·4	2	31·5	2=	—	0·5
Gezira Main Crop (Sakel)	94·4	2	28·5	26·9	2	—	0·1	46·9	4	13·1	3	—	—	112·4	3	31·5	2=	—	—

The " probable corrections " given in the Table are based on the deviations of the average yield values of adjacent beds, taken three at a time, from the mean values of the three varieties which happen to occur in those beds.

The correction obtained, though itself only an estimate, may be expected to show at least the *direction* in which the average yield values obtained have varied from the true value for each variety owing to irregularities in soil.

In the present case it will be noted that the application of the correction would bring Sakel 186 on a level with or below Fouadi at Shambat, whilst at Medani the yield of lint from Shambur Sakel IV would slightly exceed that given by Gezira Main Crop. At Barakat the only effect is to suggest that Gezira Main Crop was actually superior to Sakel Bolland 19·3 in lint yield.

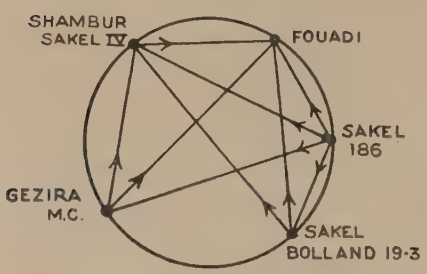
The data from these three plots have been examined by Fisher's analysis of variance method with the following results :—

Shambat
- Standard error of experiment = 1·459.
- Variance due to varietal differences : highly significant.
- Variance due to soil differences between blocks : barely significant.

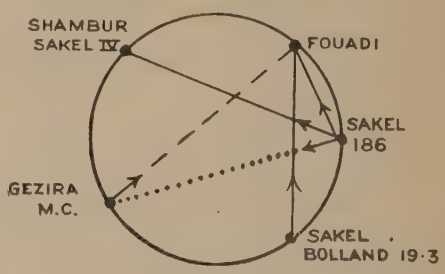
Medani
- Standard error of experiment = 1·162.
- Variance due to varietal differences : highly significant.
- Variance due to soil differences (blocks) : significant.

Barakat
- Standard error of experiment = 2·131.
- Variance due to varietal differences : highly significant.
- Variance due to soil differences (blocks) : „ „

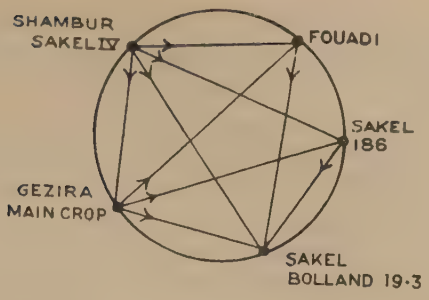
The degree of significance of differences between mean variety yields is indicated by the " *Circle diagrams* " given below (significance determined by " t " test). When the difference between any two varieties is fully significant the varieties are joined by a solid line in the diagram ; when it is only just significant they are joined by a broken line, and when nearly but not quite significant by a dotted line.



BARAKAT



MEDANI



SHAMBAT

The arrow in each case leads from the variety with the higher observed yield to that with the lower. Varieties which are not significantly different are left unjoined.

The results given above in the circle diagrams indicate the varying degrees of significance of differences between varieties under the actual conditions of the experiments. Though it is impossible to apply the " t " test to the " corrected " yields (see above), it is permissible to say that the corrections obtained indicate that, at Medani, Shambur Sakel IV should probably have been significantly higher than Fouadi and not significantly lower than Sakel 186.

(B) *I.* American Varieties. Line Test.

This experiment was conducted under irrigation at Shambat, in a precisely similar manner to the Egyptian varieties Line Test described above.

Delrect I was used as the " control " and nine varieties, in addition to the control grown against itself in two positions, were tested. Most of these " varieties " are new selections made at Shambat, and several have given very promising results, as shown below. Further details as to their origin, lint quality, etc., will be found in the section dealing with " Propagation."

The experiment was sown on the 4th of August on ridges 90 cms. apart, each " triplet " (of a variety line and its control lines on either side) being separated from adjacent triplets by a ridge sown with " adds " (*Cajanus indicus*).

Germination was somewhat irregular, but the final stand obtained was fairly satisfactory, steps being taken to make the stand within the three lines of any one triplet identical, both as regards total number of plants and their distribution along the line. Growth was strong without being too luxuriant and yields would probably have been very high but for the havoc wrought by a very severe attack of Sudan bollworm early in the season. No other pests were of major importance ;

slight Leaf Curl symptoms became general by the extreme end of the season, 20–30% of plants showing slight infection, but no marked varietal differences could be detected. Pink bollworm destroyed the tail end of the crop.

The yields of the control lines averaged 800 rottles per feddan, and, compared with the varieties being tested, the control lines were of average height and vigour.

Taking into account the preliminary nature of the test and the fact that in the case of most of the varieties only a few ounces of seed were available, the results may be considered highly satisfactory in as much as it is possible to draw very clear distinctions between the apparent yielding power of the different types.

Comparing the yield of each variety line with the average of the control ridges on either side of it, the varieties may be placed in classes as follows :—

		G.O.T.	*Halo. mms.*	*Boll Wt. grms.*
Extremely Heavy Yielder	X.A.129	31·9	28·9	3·5
Very Heavy Yielders	X.A.02629 ...	30·3	34·9	5·3
	X.A.1129 ...	31·8	31·5	3·7
Heavy Yielders	X.A.2529... ...	29·8	35·8	5·1
	Uganda S.G.27 ...	27·7	36·6	4·0
Normal Yielders	X.A.02829 ...	29·4	34·9	4·7
	Uganda S.G.29 ...	28·1	36·6	4·1
	Delrect II ...	32·2	35·1	5·2
	Delrect I ...	31·8	34·8	4·9
Rather Poor Yielder	Coker's Deltatype Webber No. 5 ...	31·8	34·9	4·7

The only modification to this classification suggested by field observations is that probably both Uganda S.G.27 and S.G.29 were handicapped by having a higher percentage of resown plants in the final stand, due to poor initial germination of the seed of these two strains, and both might be promoted to one class above their positions shown above. The same applies to X.A.02829 but to a smaller degree.

The ginning out-turn and average weight of seed-cotton per boll shown above for each variety was obtained from a special picking of one hundred healthy bolls between the second and third bulk pickings, and the halo length given is the average of 40 combed sub-basal seeds from the same special picking.

In addition to the yield figures, which were obtained by seven separate pickings between the end of November and the middle of March, and the G.O.T.s, etc., already given, records were made on height, vigour, node development rate, position of lowest sympodium and lowest effective sympodium, number of boll loculi, weight of

100 seeds, lint index and number of seeds per loculus. Photographs of typical plants were taken and lint samples kept from each variety.

Flower counts were carried out on nine occasions during the growing season. On each occasion the flowers open on three consecutive days were counted and the figures averaged. The results of these flower counts compare on the whole very closely with the yield figures, heavy flowering in a variety (compared with its control lines) being followed by high yield in comparison with controls. Exceptions to this were Uganda S.G.29, and to a less extent Uganda S.G.27 and Coker's D.W. No. 5, in each of which the yields fell below the promise of the flower count figures, presumably due to heavier boll shedding of these varieties. X.A.2529 on the other hand gave a somewhat higher yield than its flower count figures would suggest in comparison with its controls. Coker's D.W. No. 5 gave satisfactory early flowering and a fair early yield but fell away badly later. X.A.1129 showed exceptionally heavy early flowering which was borne out by extremely heavy early picking weights, whilst X.A.129 both started early and continued late in flowering and cropping, giving easily the highest yield in the whole experiment.

From the node count figures it would appear that the two Uganda types S.G.27 and S.G.29 were slightly faster in total node production, but at the same time formed their lowest sympodia (lowest and "lowest effective") one to one and a half nodes higher than the control type. X.A.1129 and, to a less extent, X.A.129 were distinctly quicker in total node production while still bearing sympodia as low as the control.

X.A.1129, X.A.129 and X.A.2529 were noted on the field as being very erect, shapely, vigorous types. X.A.02629 was a satisfactorily erect, tall, graceful, tapering plant, while the two Uganda types were of a rather lax, slender, tall growth, distinctly more inclined to lodge than the other varieties. Uganda S.G.29 was considered the more attractive of the two. Coker's D.W. No. 5 lacked vigour. Delrect II was indistinguishable from Delrect I in field characters.

(B) *II.* Variety Tests—American Types (Standard Series) Irrigated and Rain-grown.

A series of eight plots was laid down on exactly the same system as in previous years, the only difference from last year's series being the change in locality of the two Mongalla plots, referred to in the introductory portion of this section. The new plot at Kirrippi was typical of the flatter areas of medium loam overlying laterite sub-soil

on which most of the cotton in this district is planted. The Opari plot was on rather more sandy sloping land at the foot of a hill. The rainfall of this district is normally a little less than that of Yei District and the rainy season of shorter duration. Some 700 bales (of 500 lbs.) of lint were produced here by native cultivators in 1930/31, the seed issued being Pump Scheme Strain.

All the other plots were situated in the same districts as last season, but on different actual sites, either new positions or previous sites brought in under a rotation. The local conditions of soil and rainfall and the general prospects of each of these districts have been already discussed in previous reports.

A full list of the plots is given at the beginning of this section of this report. The size of the plots (5 feddans in the case of the two irrigated plots and 3 feddans in the rain-grown areas) and all details of the layout (except the spacing of the plants) were identical throughout the series, and exactly as in previous years. Each plot contained 27 equal strips including a " belt " strip at each end, the inner 25 strips being divided into 5 blocks giving 5 repetitions of 5 varieties. The position of the varieties within the blocks was " balanced " but otherwise the arrangement of varieties was random.

The varieties grown were, as in previous seasons, the same throughout the whole series, irrigated and rain-grown, so that valuable deductions can be drawn from the relative behaviour of the different varieties in the various localities.

The varieties thus tested this season were :—

Delrect II.
Pump Scheme Strain.
X.A.2728.
Parnell's U.4.
Uganda N.17.

In addition Webber 49 Strain 2 was grown in one belt bed at each place in order further to try it out against the varieties included in the test proper. Coker's Delta Type Webber No. 5 was similarly tried in the other belt of all the plots except at Talodi, where it was replaced by Tanguis in order to give this type a preliminary trial under rainfall.

The following are brief details relating to the individual plots :—

Shendi (Irrigated).—On the same site (on the Forage Farm) as the plot of 1926/27. First sown on July 11th and re-sown on July 25th but the whole plot practically wiped out by locusts in mid-August so that the few remaining plants had to be pulled up and the whole plot sown afresh on August 21st. Again resown heavily (20–60%) on September 5th. Thinned and spaced on September 29th. Final spacing 90 by 90 cms. Final stand varying from 92 to 100% full. Picking commenced December 9th, four pickings only taken, ending February 3rd.

In view of the abnormal, extremely late sowing and very heavy resowing (two months after the optimum sowing period) the results from this plot must be regarded as of very limited value indeed, apart from the unreliability introduced by differential re-sowing and varying final stand of the different varieties.

Moeis (Irrigated). On the Experimental Farm, the same site as in 1927/28. Sown July 10th and re-sown, very heavily, on July 24th (the beds of Uganda N.17 requiring up to 60% of holes re-sown). Badly damaged by locusts at the same time as the Shendi plot, but in this case the plants were not entirely destroyed and four out of the five "blocks" were left to recover, the worst block being cut right out of the experiment. Thinned on September 30th. Final spacing 90 by 90cms. (2 plants per hole). Final stand poor in some beds especially Uganda N.17 (as low as 77%) and Parnell's U.4 (down to 81% in one bed). Weeds bad and irregularly distributed. Five pickings taken between November 17th and February 4th.

This plot also must be regarded as very unsatisfactory from the point of view of probable reliability of results, as apart from the loss of "balance" introduced by arbitrarily cutting out one block of beds from the results, and the effect of the locust damage on the remainder of the plot, both the amount of re-sowing and the final stand showed big differences between beds which were not "random" but definitely correlated with certain varieties. The two varieties the seed of which was imported from outside the Sudan, Uganda N.17 and Parnell's U.4, were badly handicapped by these factors, both showing consistently poorer germination than "native" seed.

Bueda (rain-grown).—On a new site on Galaa El Nahal Experimental Farm, adjacent to last year's site. Sown July 7th, re-sown lightly July 22nd. Final spacing 66 by 90cms., thinned and spaced on August 18th and September 4th. Final stand fairly satisfactory 92–100% (no one variety being particularly handicapped). Weeded four times. The soil was deep heavy hard-set "black cotton soil" (similar to previous plots here) in which cotton roots hardly penetrated beyond 18 inches downwards. The site was newly cleared, having previously carried light thorn forest. No ploughing was done in this district. Rainfall deficient; much below that received at this station last season. Growth was fairly even over the plot, no large patches of stunting or extra vigour being marked. Pests were not serious, fleabeetle and bollworm were general but slight. Blackarm infection was very light. Black ants had destroyed plants in two small areas reducing the stand of Beds 16 and 17 to 92% each. Shedding was very heavy and the plants showed very little vegetative growth. There was no lodging.

The results here may be regarded as quite a reliable indication of the capabilities of the varieties under very unfavourable conditions of rainfall.

Fau.—A new site (near Galaa El Nahal station) adjacent to last years site. Sown July 13th. Re-sown lightly July 29th. Thinned and spaced August 19th and September 5th. Final spacing 66 by 90cms. (2 plants per hole). Final stand very good, 95–100% (rarely below 98%). The soil was almost identical with that of Bueda, and again it was newly cleared from light wood. Rainfall very deficient. The growth was even poorer than at Bueda and the yields smaller still. Vigour was far from regular over the plot, but the irregularities were all small scattered patches, and no one bed or one particular variety appeared badly handicapped in comparison with others. Fleabeetle did more damage here than at Bueda but the attack appeared late in the season. Blackarm was very slight and no other diseases or pests were serious. The plants nowhere exceeded 60cms. in height, and none of the varieties showed any lodging.

The results, in spite of the extremely small yields, show statistically significant differences and may at least be regarded as a useful confirmation of the results of the Bueda plot, the order of the varieties for yield (with "corrections") being closely the same at the two places.

Talodi.—The same site as in 1928/29 on Talodi Experimental Farm. Sown June 12th, re-sown July 7th (rather heavily, Uganda N.17 requiring more than the other varieties). Thinned and spaced August 1st and 7th. Final spacing 75 by 90cms., two plants per hole. Final stand good 94–100% (Uganda N.17 being slightly the poorest but not below 94%). Weeded four times during the season. The area had been ploughed and fallowed since the cotton crop of 1928/29. The soil was a light loamy "cotton soil". Rainfall from May to November totalled 826 mms. and was fairly well distributed, but rather light in June and July, and a little excessive in August. Fleabeetle and various bollworms occurred, pink bollworm infestation reaching 10–20%. There was no red bug (stainer) damage and no Leaf Curl was seen. Blackarm damage was very severe throughout, symptoms being found on all varieties in December, although at that time the disease had ceased to be active. Growth was fairly strong and very regular throughout the plot and shedding of buds and bolls moderate only, resulting in a very satisfactory yield. Seven pickings were taken between October 17th and February 3rd. All the varieties showed a satisfactory erect habit except Uganda N.17 which was quite badly lodged.

The results from this plot may be taken as quite reliable and representative of the capabilities of the varieties in this district. Uganda N.17, however, must be regarded as a little handicapped by heavier re-sowing and slightly lower final stand. Of other external conditions modifying the results only Blackarm need seriously be considered. Although all varieties showed heavy damage and none could be distinguished as being more resistant to infection than another, there seemed to be a difference between them in their reaction to the disease. The more vigorous "late" types (Parnell's U.4 and Pump Scheme Strain) appeared to be able to "grow away" from the attack, while the "early maturing" types (Delrect and X.A.2728) were unable to recover so fully from the damage done by the disease during September and October.

Kadugli.—On Kadugli Experimental Farm, the same site as in 1927/28 and 1928/29. Sown June 23rd, germination and early growth a little slow and irregular owing to poor rains. Re-sown rather heavily July 20th (Uganda N.17 requiring by far the most). Thinned and spaced August 15th and 23rd, final spacing 75 by 90cms., two plants per hole. Final stand quite good and regular, 94 to 99% (Uganda N.17 attained 96% in the final stand). Weeded five times during the season. The area had grown cotton in 1928 and was fallow in 1929, during which it was ploughed. The soil was light-brown "cotton soil". Rainfall totalled 695mms. between May and November inclusive, it was rather light and irregular in June but well distributed afterwards until mid-October. Insect pests were bad, white ants attacked seedlings in August, stemborer, thrips, stainer-bug and Sudan, Egyptian and pink bollworms were all reported to have occurred. In December bollworm infestation was quite severe, a large number of bolls being destroyed, while fleabeetle had riddled almost every leaf. Blackarm was evidently quite severe early in the season, stem lesions being numerous, while angular

leaf-spot was still active and very extensive in December, on all but the very newest leaves. No Leaf Curl was seen. Growth was vigorous and tall (up to 150 cms.) and none of the varieties lodged badly (Uganda N.17 was somewhat the least erect, Delrect the most). The plot was of regular fertility except for one bad trough of stunted plants where the surface was low and water lay after heavy rains. This severely handicapped bed 13 (X.A. 2728), probably reducing its potential yield by at least a quarter. Beds 14 and 16 (Pump Scheme Strain and Parnell's U.4) were also slightly affected. Shedding was heavy throughout, the plants dried off earlier than at Talodi and the yield was somewhat lower, for which both insect pests and lower rainfall figures were probably responsible. Five pickings only were taken between October 31st and January 4th.

The statistical results should be quite reliable as they stand, except that the heavier re-sowing of Uganda N.17 and the stunting in Bed 13 (the effect of which cannot be eliminated by the three-bed mean correction system) should be remembered.

Kirrippi.—A new site (the first standard variety test in this locality). Sown July 2nd, germination slow and irregular. Re-sown July 30th (Uganda N.17 heavily, the other varieties lightly only). Thinned and spaced August 13th and September 1st. Final spacing 90 by 100 cms. Two plants per hole. Final stand very variable (from 63 to 99%), a large area, which involved 10 of the beds (Nos. 3 to 13) had a tremendous number of blank runs and patches containing as few as one-third of the full number of plants, due it was reported, entirely to the depredations of white ants amongst the young plants when it was too late to continue re-sowing, and carrying on even after the final thinning. (White ants were still obviously numerous here in December, the stems of many of the surviving plants being coated with their earthern galleries.) Weeded seven times during the season (entirely free from weeds in December). Previous to sowing, the land had carried a heavy growth of grasses and had been burnt and cleared by hand, no ploughing being done in this district. The soil was a firm medium loam with some rocky fragments over laterite. Rainfall from June to December totalled 862 mms. but was not well distributed. The greater part of July (immediately after sowing) was without rain, September was deficient and November also quite dry, after perhaps too much rain in October. Growth was however quite vigorous, averaging over one metre high. It was fairly even over the plot, irregularities being scattered and not penalizing any one variety. Insect pests (other than white ants) were not serious, red bug (stainer) and bollworms were slight only, and fleabeetle not heavy. No Leaf Curl was found. Blackarm, judged in December by signs of old lesions, was probably quite bad. It was reported active in the wet weather of October. Angular leaf-spot was very slight by December. Shedding of bolls, judged by the blank nodes on plants in December, must have been very heavy on all varieties and probably accounts for the lower yield here on a plot of equal vigour to that of Talodi. None of the varieties were so erect here ; Parnell's U.4 was quite badly, and Uganda N.17 very badly lodged.

The results here ought not to be considered without taking into account the differences in the final stand (as well as the differential re-sowing recorded above). The stand of the different varieties averaged out (on the five beds in each case) as follows :—

Delrect	96%
Pump Scheme Strain	90%
X.A.2728	88%
Parnell's U.4	
Uganda N.17	81%

As these reduced stands were almost entirely due to large blank spaces and not to scattered, single blank holes, little " compensation " by extra growth of neighbouring plants can have taken place, and very roughly the yields may be considered to have been reduced in the same proportion.

Opari.—A new site (the first standard variety test in this locality). Sown July 15th, germination rather slow and irregular. Re-sown August 10th (rather heavily in almost all beds, but Uganda N.17 and Parnell's U.4 required more than the other varieties). Thinned and spaced August 30th and September 19th. Final spacing 90 by 100cms., two plants per hole. Final stand mostly very good (over 90%) until elephant damage occurred. (Uganda N.17 was only very slightly handicapped in respect of final stand.) In October a herd of young elephants broke into the plot and by browsing on and bodily pulling up the plants from the soft ground, cut a wide diagonal track across the first ten beds, completely ruining the first three and taking 20% of the plants from the fifth and sixth. The first " block " of five beds (one of each variety) as well as the first belt bed, was therefore cut right out of consideration in taking the yields from this plot. The damage to beds 7, 8, 9 and 10 was slight, and roughly equal from one bed to another so that the yields taken from the four remaining blocks of the experiment were not greatly affected. The plot was weeded six times. The soil was distinctly light and more friable than at Kirrippi, and still contained considerable subsoil moisture at 4 feet deep in early January. Rainfall was very much the same as at Kirrippi (800mms.) but rather more fell in July before and following the sowing of the plot, and less at the end of the season. Growth was at least as vigorous as at Kirrippi, the plants being rather taller (average 130 cms.) and also more erect. Regularity of vigour over the plot (excluding the first block) was satisfactory. Red Bug was bad at the end of the season but no other pests appeared numerous. Bollworms were few. No Leaf Curl occurred. Blackarm, judged by old lesions and blackening of stems and sympodia in January, appeared to have been very bad indeed earlier, and angular Leaf-spot was still general and bad even on the younger leaves. It was too late in the season to obtain any reliable comparison of severity of infection between varieties.

The yield figures obtained from this plot, in spite of the cutting out of one block of beds, should be quite trustworthy if the handicapping of Uganda N.17 by heavier re-sowing and slightly lower final stand is remembered. The same impressions were gained as at Talodi (which see) of the varying effect of Blackarm attack on the different varieties.

The average yield of lint per bed and the order of yield of the five varieties (on the " uncorrected " figures), followed by the " probable corrections " in each case (where they are applicable), is shown in the following table for each of the eight plots of the series. A fourth column shows the ginning out-turns of the total crop of each variety. Ginning out-turns for each picking separately were calculated and used in obtaining the lint weights ; the total ginning out-turn figures remain of interest in considering costs of transport and ginning of the seed-cotton, and are given in the same table for reference.

In addition, the average yield of seed-cotton for the whole experiment, expressed as rottles per feddan, is given immediately below each of the plot names.

Following the table will be found the circle diagrams.

Explanations of " circle diagrams " and " probable corrections " will be found in the portion of this section which deals with Egyptian standard variety tests.

The circle diagrams show the relative position of the different varieties and the degree of significance of their *observed* differences in yield, as shown by the " t " test, but naturally cannot take into account the modifications which are indicated by the use of the " probable correction " method nor those suggested by the detailed field observations made on germination, stand, etc. To deal with these in detail, plot by plot, would occupy too much space, but, taking all the above corrections into account and remembering the special conditions in the various localities, we may make the following broad deductions as to yield of lint.

Under irrigation (at Shendi and Moeis) Pump Scheme strain, as was expected, remains supreme. The new Shambat production, X.A.2728, takes second place, and the other three varieties, all of which were included here only because they occur in the series, and were primarily chosen for rain-grown conditions, were less successful. Even here, however, Parnell's U.4 has done comparatively well.

At Bueda and Fau under extremely unfavourable conditions of rainfall, the success of X.A.2728 is marked, it shows significantly higher yields than any of the others, including the known drought-resisting type Parnell's U.4 which occupies second place. There is little to choose between the other three varieties.

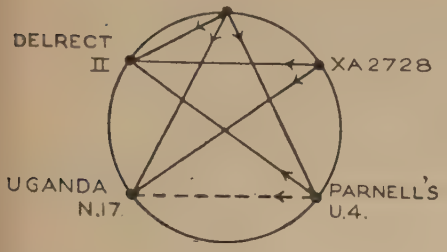
At the other four stations, under more normal and more nearly comparable conditions, Parnell's U.4 scores a striking success, giving significant increases over all the other types at each place, due in a considerable degree to its relatively very high ginning out-turn. In the Nuba Mountains District, Pump Scheme Strain occupies the second place for yield, but is closely followed by X.A.2728 and Delrect. Uganda N.17 occupies the fifth position here, " significantly " below all the others, but part of its apparent inferiority must be discounted when the handicaps of re-sowing and stand are remembered. Even so, it is probably not a successful type for this district, compared with the others tried. In both the Mongalla plots it rises to second place (with corrections) while Pump Scheme Strain is third, and X.A.2728 and Delrect are brought down to 4th and 5th respectively.

These differences in the results between Nuba Mountains and Mongalla are such as might be expected from the differences in conditions. The slightly heavier rainfall over a distinctly longer wet season in Mongalla favours the vigorous " long period " cropper (Uganda N.17)

Plots—	Shendi.				Moeis.				Bueda.				Fau.				Talodi.				Kadugli.				Kirkipi.				Opari.			
Varieties	Average Net Yield of Seed-Cotton per feddan 606 rottles.				Average Net Yield of Seed-Cotton per feddan 1304 rottles.				Average Net Yield of Seed-Cotton per feddan 358 rottles.				Average Net Yield of Seed-Cotton per feddan 84 rottles.				Average Net Yield of Seed-Cotton per feddan 1226 rottles.				Average Net Yield of Seed-Cotton per feddan 1045 rottles.				Average Net Yield of Seed-Cotton per feddan 994 rottles.				Average Net Yield of Seed Cotton per feddan 754 rottles.			
	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.	Yield of Lint per Bed.	Order of Yield.	Probable corrections to Yield of Lint.	Ginning Out-turn.
Delrect II	14·6	5	+ 1·0	28·1	30·0	5	Not applicable.	23·6	9·5	2 (=)	— 0·2	25·6	1·4	5	+ 0·1	20·3	33·1	4	+ 0·5	29·9	29·8	3	— 0·3	28·7	23·4	5	Not applicable.	28·5	14·4	5	+ 0·6	29·3
Pump Scheme Strain	29·1	1	— 0·8	29·0	58·4	1		27·7	9·4	2 (=)	— 0·2	27·4	1·7	3 (=)	0·0	25·8	39·2	2	+ 0·1	30·0	32·1	2	— 0·6	29·5	30·0	2		29·4	23·3	3	+ 0·8	29·5
X.A. 2728	24·3	2	— 0·2	28·2	46·0	2		25·2	11·4	1	— 0·2	25·9	3·0	1	— 0·1	23·6	36·5	3	— 0·6	28·1	28·6	4	+ 0·6	27·4	27·9	3 (=)		27·2	20·9	4	— 0·3	29·0
Parnell's U.4	23·5	3	0·0	31·2	41·8	3		28·0	8·8	4 (=)	+ 0·7	28·9	2·4	2	— 0·2	27·1	44·5	1	— 0·3	33·0	35·8	1	+ 0·1	31·9	37·2	1		32·3	29·5	1	— 0·3	32·7
Uganda N.17	18·4	4	— 0·6	27·8	36·6	4		25·5	8·7	4 (=)	— 0·4	26·6	1·8	3 (=)	0·0	24·7	30·1	5	0·0	28·1	25·4	5	— 0·3	27·3	27·8	3 (=)		28·3	24·9	2	— 0·2	29·2

SHENDI

PUMP SCHEME STRAIN

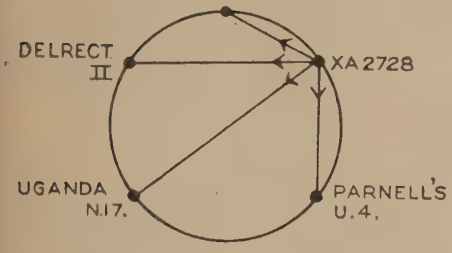


MOEIS

PUMP SCHEME STRAIN

BUEDA

PUMP SCHEME STRAIN



FAU

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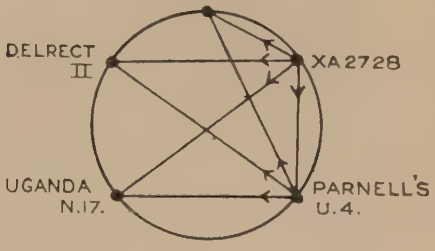
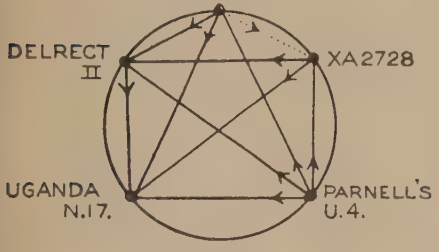


TALODI

PUMP SCHEME STRAIN



KADUGLI

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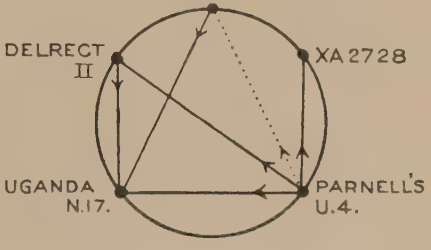
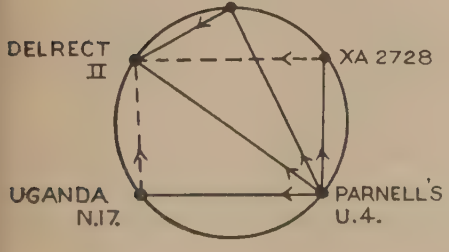


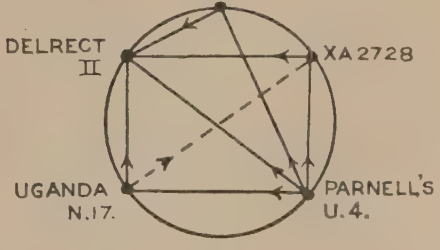
KIRRIPPI

PUMP SCHEME STRAIN



OPARI

PUMP SCHEME STRAIN



and Pump Scheme Strain) at the expense of the " early " types such as Delrect and X.A.2728. The success of Parnell's U.4 in both emphasizes the adaptability of this strain.

The yields from Delrect might be considered disappointing and at variance with the results of tests in previous seasons, but it must be remembered that it is this year competing with three new types selected for high yield. In the Nuba Mountains plots it is little inferior to Pump Scheme Strain in yield, without taking lint values into account. It does not, however, appear to be the most suitable type for districts of more prolonged rainy seasons such as Mongalla. Last year it was concluded that Delrect in the Nuba Mountains district would give a slightly better return than Pump Scheme Strain, when the extra price obtainable for Delrect was taken into account. This year this is not the case and the different result is due to a considerable extent to the fact that Delrect has on the average given a definitely lower ginning out-turn than Pump Scheme, although last year the reverse was the case.

X.A.2728 has given satisfactory results, especially when it is remembered that this strain is to be regarded more as a forerunner of further improved " off-type " selections from Columbia now being bred at Shambat, than as an established variety itself. (These later productions may confidently be expected to show further improvements in yield, G.O.T. and quality, and on the results shown by X.A.2728 may be tried with confidence in all districts, but more especially in those of shorter rainy season. A strain of equal cropping power and vigour, with improved G.O.T., would probably beat Pump Scheme Strain in most districts and even under irrigation.) Parnell's U.4, as already pointed out, has proved an outstanding success in both Nuba Mountains and Mongalla, combining heavy yield of seed-cotton with consistently high G.O.T., and, should it show such decisive superiority over Pump Scheme Strain in a second season, it might well replace it in these districts, pending the production of strains of higher lint quality able to compete with it in yield.

The results from Uganda N.17 in Mongalla tend to confirm the assumption that strains found to do well in Uganda should grow successfully in the Southern Sudan, and augur well for the prospects of Uganda S.G.29 in the coming season's variety tests. For the North it is not a successful type, and its liability to lodge so badly, and also its low G.O.T., are serious disadvantages.

We have received valuations on samples of all these cottons grown in 1930/31 at Moeis, Kadugli and Kirrippi. With the help of these it is possible to make some sort of estimate of the gross cash return per

feddan given by these varieties. It must be remembered, however, that the estimate will be only a rough approximation, as the valuations apply only to samples taken from one particular picking of the crop in each case. Further, it is unfortunate that in the case of two of the plots sampled it has not been possible to apply corrections to observed yields.

As the plots go in pairs—one pair in each district—it is perhaps permissible in the present case to take the average yield for each pair, employing " corrected " yields where available, in working out the cash return per feddan.

This has been done in the following table :—

ESTIMATED GROSS CASH RETURN PER ACRE.

	Delrect.	*Pump Scheme Strain.*	*X.A. 2728.*	*Parnell's U.4.*	*N.17.*
Average for Shendi and Moeis (irrigated) (based on Moeis prices) ...	£5·2	£8·7	£7·8	£6·7	£6·0
Average for Talodi and Kadugli ... (based on Kadugli prices)	£7·7	£8·3	£8·0	£9·7	£7·0
Average for Opari and Kirrippi ... (based on Kirrippi prices)	£5·2	£6·4	£6·3	£8·1	£6·9
Average for Bueda and Fau ... (based on *Kadugli* valuations)	£1·3	£1·2	£1·7	£1·4	£1·3

Further details from the Graders' reports will be found in the special section of this report which deals with that subject. It will be seen, however, that Parnell's U.4 stands out very strongly as the most valuable type yet tried in Mongalla and the Nuba Mountains. In the water-starved plots in the Gedaref district, the new selection X.A.2728 is the only variety which stands out in any prominence, the others giving very similar returns.

Apart from varietal differences in the ginning out-turns it is interesting to note the very low percentage out-turns from Bueda and Fau, that of all the varieties being brought down in proportion. Once more, therefore, as recorded in previous reports, drought conditions and low G.O.T.s are associated. The figures for each variety at Kadugli will be seen to be a little below those of the same variety at Talodi, and again rainfall figures show a difference in the same direction.

The same tendency, as recorded last season, for the G.O.T.s of the separate pickings to decrease as the season advances, but to rise again for the last pickings, was shown at Talodi and Kadugli. At Kirrippi and Opari the figures remained steady throughout At Bueda they

fell off sharply and the last picking gave extremely low figures. The abnormal conditions at Shendi and Moeis seem to be reflected in the somewhat irregular figures, but it will be noted that they all tend to be rather low in conformity with general results from the Pumping Stations this season.

Regarding the " Belt " beds of these test plots, the general inference from the yields, compared with that of the varieties within the test proper, and taking into account the field notes and ginning data obtained, is as follows :—

Webber 49 strain 2 cannot compete with either Pump Scheme Strain or Delrect in any of the localities (irrigated or rain-grown), thus fully confirming results of tests in previous seasons.

Coker's Deltatype Webber No. 5 is very similar to, and in no way superior to Delrect. Under irrigation at Shendi and Moeis its yields were inferior and under rainfall it lacked vigour.

The single bed of Tanguis at Talodi gave interesting results. It grew vigorously, but was early attacked by Blackarm with almost completely fatal results to 50% of the plants, while most of those surviving consisted of little but a blackened framework, with slight fresh growth from low down on the main stem, when seen in December. A few plants only appeared to have escaped serious damage, and had retained the growing point of the main stem. These made big, vigorous bushes with plenty of foliage and flowers, but even then bore practically no crop, as shedding, apparently apart from Blackarm, was almost complete. The yield of the bed was negligible.

5. Graders' Tests.

We are fortunate this year in having been able to get our samples home in sufficient time to allow of the inclusion in this report of the results of graders' tests relating to the 1930/31 crop. We are specially indebted to Mr. Charles Wolstenholme for kindly giving up so much of his time in order that these results might be available.

The graders' reports for the previous season (1929/30) have not previously been dealt with by us, so that in the present case we have the results of two seasons before us. These results are of the greatest value to us in arriving at decisions as to what kinds should be further propagated, but it is not possible, in a report of this nature, to attempt to give the results in full.

As far as possible the results from the examination of the 1930/31 crop have been included in the particular sections of this report which deal with the propagation or field-testing of the varieties concerned.

In the present section we will give only certain extracts from the 1929/30 and 1930/31 reports relating to varieties or strains which appear to be of special importance or interest at the present time.

The Shambur-Sakels. This group has assumed very considerable importance at the present moment in view of the very high degree of resistance to Leaf Curl disease shown by the strains which are comprised in it.

"SHAMBUR-SAKEL I" is to all intents and purposes a mixture of the four other types ("II" to "V"). It was grown in a variety test at Wad Medani in 1929/30, against Gezira Main-crop Sakel with the following results :—

Shambur I.—"Sakel character. Strict Good. Very light in colour. $1\frac{1}{2}'' - 1\frac{5}{8}''$. Very irregular and mixed with short and wasty. Medium strong. Fairly lustrous but wanting in fineness. 11·50d."

Gezira Main Crop Sakel (for comparison).—"Fully Good. Fair colour. $1\frac{3}{8}'' - 1\frac{1}{2}''$. Wasty. Medium to strong. Rather wanting in lustre and fineness. 11·0d."
(Based on September Sakel. 9·00d.)

NOTE.—A sample of Sakel, supplied by Sudan Plantations Syndicate, mark S.S., examined at same time was priced at 11·25d. (Fully good) and described as "$1\frac{3}{8}''$", very wasty, strong, fine and lustrous.

"SHAMBUR SAKEL IV" has so far been considered to be the most promising substrain of this type. Graders' reports are available on samples grown in the Preliminary Variety Test at Shambat in 1929/30 and in the Standard Variety Test at Medani in 1930/31. The results are given below, along with reports on "ordinary" Sakels grown alongside in each case.

1929/30 crop.

Shambur IV.—"Sakel character. Medium colour. $1\frac{1}{2}'' - 1\frac{3}{4}''$. Medium to strong. Lustrous and fine. 12·50d. (Fine)."

Sakel (for comparison).—"Rather brown. $1\frac{1}{2}'' - 1\frac{5}{8}''$, regular. Strong. Rather wanting in fineness and lustre. 11·75d. (Fully good)."
(Based on September Sakel. 9·00d.).

1930/31 crop.

Shambur IV.—"Sakel colour. $1\frac{3}{4}''$ mixed with short. Medium strong. Rather wanting in lustre and fineness. 7·26d. (Barely good)."

Gezira Main Crop (for comparison).—"Rather brown in colour. $1\frac{5}{16}''$. Medium strong. Wanting in lustre and fineness. 7·26d. (Good to fully good)."
(Based on July Sakel. 7·26d.).

"SHAMBUR SAKEL III" is the next most promising strain. It was grown in 1929/30 and 1930/31 in the same plots as Shambur Sakel IV and the comparisons with standard Sakels given above apply in this case also.

1929/30 *Crop. Shambur III.*—"Sakel character. Light colour. $1\frac{1}{2}''$. Rather wasty. Medium strong. Fairly lustrous and fine. 12·00d. (Fully good)."

1930/31 *Crop. Shambur III.*—"Sakel colour. $1\frac{5}{8}'' - 1\frac{3}{4}''$. Rather irregular. Medium strong. Fairly lustrous and fine. 7·76d. (About good)."

Hybrid Sakel and Sea Island Types. (For further details see section dealing with Propagation and Line Tests.)

Hybrid X.H.529.—A small sample of this strain from the 1929/30 crop was described as being "very nice cotton—would compete with best Kassala Sakel". Further samples were submitted from the 1930/31 crop, when, in common with all other types, the quality was considerably less good. The details are given below, along with those for other hybrids which have now reached the propagation stage. It should be noted that, with the exception of X.H.529, all these hybrids are *highly resistant to Leaf Curl disease.*

1930/31 *crop.*

X.H. 529.—"Light colour. $1\frac{3}{4}$". Irregular. Medium strong. Moderately fine and lustrous. 8·51d. (Good)."

X.H. 1029.—"Light colour. $1\frac{3}{8}$" – $1\frac{5}{8}$". Irregular. Medium. Wanting in fineness and lustre. 8·01d. (Good)."

X.H. 1229. "Light colour. $1\frac{3}{4}$". Irregular. Very strong in places. Moderately fine and lustrous. 8·76d. (Good)."

(Based in all cases on July Sakel. 7·26d.).

American Cottons.

Delrect. This selected strain of Delta Webber cotton has now reached a stage when considerable quantities of seed are being distributed for general cultivation in areas of rather low rainfall.

The graders' reports for 1929/30 and 1930/31 have been satisfactory, but cannot be given in full here. It will be sufficient to record the valuations given to samples from various plots, together with valuations given to samples of "Pump Scheme Strain" and "Webber 49" *from the same plots*, for comparative purposes.

Year.	*Locality.*	*Variety.*	*Grade.*	*Strength*	*Valuation.*	
1929/30	Gedaref (Bueda)	Delrect I ...	About Mid-Fair	Medium	7·40d.	September American futures 5.80d. 23/9/30.
		Webber 49 ...	Strict G.M.	Medium	6·80d.	
		Pump Scheme	Mid-Fair	Weak	6·55d.	
1929/30	Nuba Mountains (Talodi)	Delrect I ...	G.M.	Medium	6·80d.	
		Webber 49 ...	G.M.	Weak to Med.	6·65d.	
		Pump Scheme	G.M. to Strict G.M.	Med. to Strong	6·70d.	
1929/30	Mongalla (Kagelu)	Delrect I ...	S.G.M.	Weak	6·60d.	
		Webber 49 ...	S.G.M.	Medium	6·70d.	
		Pump Scheme	G.M. to Strict G.M.	Medium	6·30d.	
1930/31	Nuba Mountains (Kadugli)	Delrect II ...	S.G.M.	Weak to Med.	5·86d.	July American futures 4.96d. 22/7/31.
		Webber 49 ...	G.M. to S.G.M.	Weak	5·26d.	
		Pump Scheme	S.G.M.	Med. to Strong	5·66d.	
1930/31	Mongalla (Kirrippi)	Delrect II ...	S.G.M.	Strong	6·46d.	
		Webber 49 ...	S.G.M.	Strong	6·21d.	
		Pump Scheme	S.G.M.	Strong	5·86d.	
1930/31	N. Sudan (Irrigated)	Delrect II ...	S.G.M.	Med. to Strong	6·86d.	
		Webber 49 ...	Barely S.G.M.	Medium	6·46d.	
		Pump Scheme	G.M.	Strong	6·06d.	

It will be seen that in all cases Delrect shows a considerable premium over Pump Scheme strain, and, in 5 cases out of 6, shows a premium over Webber 49.

X.A.2728. This is the first of a series of selections made at Shambat from Columbia cotton. These selections are of later origin than Delrect and are likely eventually to replace that type, as preliminary trials have indicated that they do well in regions of moderate or rather light rainfall.

The valuations and graders' reports on the strength, etc., of X.A. 2728 as grown in different districts in 1930/31 are given below, reports on Parnell's U.4 being included in the same table for convenience. The more important results relating to other Columbia selections will be found in the portions of this report relating to propagation work and the American Line Test.

Parnell's U.4 received its first serious test in this country in 1930/31. The Graders' reports are, on the whole, sufficiently satisfactory. They are summarized in the Table below, in which Pump Scheme strain is also included for comparative purposes. The valuations in this Table may be compared directly with those in the foregoing Table dealing with Delrect and Webber 49 in 1930/31.

Locality.	*Variety.*	*Grade.*	*Length and Strength.*	*Lustre and Fineness.*	*Valuation.*
Nuba Mountains (Kadugli)	X.A. 2728	Mid-Fair	Full 1⅛″ Weak to Med.	Fairly lustrous and fine	5·96d.
	U.4	Strict G.M.	1⅛″ Medium	Rather wanting	5·81d.
	Pump Scheme	Strict G.M.	1 1/16″ – 1⅛″ Med. to Strong	Fairly lustrous and fine	5·66d.
Mongalla (Kirrippi)	X.A. 2728	S.G.M.	Full 1⅛″ Strong	Rather wanting	6·26d.
	U.4	S.G.M.	1⅛″ Strong	Rather wanting	5·91d.
	Pump Scheme	S.G.M.	1⅛″ Strong	Rather wanting	5·86d.
N. Sudan (Irrigated)	X.A. 2728	S.G.M.	1 3/16″ with some short Strong	Rather wanting	6·71d.
	U.4	Barely S.G.M.	Full 1⅛″ Strong	Wanting	6·16d.
	Pump Scheme	G. Middling	Full 1⅛″ Strong	Rather wanting	6·06d.

July American futures on the date of examination (22/7/31) stood at 4·96d.

6. Spinning Tests and Measurable Character Determinations.

The results of tests on the 1930/31 crop are not yet available, so that the information here presented refers entirely to the 1929/30 crop.

We are again indebted to the Shirley Institute and to the Fine Cotton Spinners and Doublers' Association for kindly undertaking the tests.

The details of the field experiments to which the tests refer can be found in last year's report.

Spinning Tests on Egyptian and Related Cottons.

(*a*) Egyptian Standard Variety Test (Wad Medani, 1929/30) :—

General Order of Merit.	*Variety.*	*Count × Strength Product*		*Total Waste %*
		100/1 T.F. 2·75.	100/1 T.F. 3·6	
1 =	Gezira Main Crop ...	1700	2060	22·8
	Sakel 186	1670	2020	21·2
	Sakel B. 19·3 ...	1680	2020	21·2
4 =	Sakel B/24 ...	1780	2050	23·6
	Shambur Sakel I ...	1715	2100	22·7
	Garofallou	1710	2050	22·6
7	Pima	1400	1710	25·3

(*b*) Preliminary Variety Test (Shambat, 1929/30) :—

Order of Merit (general).	*Variety.*	*Count × Strength Product*		*Total Waste %.*
		100/1 T.F. 2·75.	100/1 T.F. 3·6	
1	Massey's Selected Domains	1970	2140	17·5
2	S.I.D.1·8	1940	2190	19·0
3	Shambur III ...	1940	2130	22·3
4 =	Shambur II ...	1930	2110	22·9
	Sakel Bolland 19·3	1830	2020	19·5
6	Shambur IV ...	1850	2010	21·8

The spinning report remarks on the fact that the samples are all—Sakels included—considerably inferior to the samples received from the previous year's crop and this should be taken into account in considering the results.

The interest of these tests centres chiefly round the behaviour of the Shambur Sakels. It is satisfactory to find that Shambur I did not give appreciably more waste than the Sakels against which it was spun, but the tendency to wastiness can be seen in the results from other strains of this type from the Shambat plot.

Spinning Tests on American Cottons.

The total number of tests made with these was twenty-five. All were spun at 60's Ring Twist, with a twist constant of 3·74 and are therefore directly comparable *inter se.*

The samples included those taken from two standard variety tests grown at Talodi (Nuba Mountains district) and Bueda (Gedaref district). The same 5 varieties were grown at each of these localities. The results are summarized below :—

1	2	3	4	5	6
Locality.	*Variety.*	*Count × Strength Product* (Lea *strength*).	*Order of Merit for Column 3.*	*Waste%*	*Order of merit for appearance of Yarn.*
Talodi 2nd Picking (Saw-ginned)	Delrect	2084	3	11·0	3
	Webber 49/2 ...	2048	4	9·6	8
	Uganda S.G.15	1830	10	9·6	10
	Wild's No. 1 ...	1915	8	11·1	4
	Pump Scheme ...	1937	6	9·7	5
Bueda 2nd Picking (Saw-ginned)	Delrect	2344	1	9·1	2
	Webber 49/2 ...	2089	2	10·3	7
	Uganda S.G.15	1905	9	10·0	9
	Wild's No. 1 ...	1923	7	9·1	6
	Pump Scheme ...	1997	5	9·4	1

It will be noted that Delrect gave the strongest yarn both at Talodi and Bueda, and also came out very high in order of " appearance " of yarns. Webber 49/2 gave the next strongest yarns, but was very much down in order of appearance. " Pump Scheme " was rather lacking in strength, but on one occasion gave yarn of very good appearance. " Uganda S.G.15 " is notably lacking in both strength and appearance of yarn and gave the highest number of breaks in a winding test. The spinning report states that the sample of Delrect from Bueda gave the *best all-round performance* of *all* the 25 American samples received from the Sudan and would probably spin satisfactorily to even higher counts.

A sample of Uganda S.G.26 from a plot immediately adjacent to the variety test at Talodi was also sent and gave results no better than S.G.15, except that breakages were less. It would appear that neither of these Uganda cottons is suited to our conditions in the Southern Sudan.

The weakest yarn of all the samples submitted was given by a sample of Pedigree Dixie. The card waste was in this case also rather heavy and the yarn uneven in appearance.

Measurable Characters (*American Cottons*).

Determinations were made on the same samples from Talodi (Nuba Mountains district) and Bueda (Gedaref district) as those used for spinning tests (see above), and also on a series of samples grown in

small adjacent plots at Torit (Mongalla district) for observation purposes.

The following table is made up from information extracted from the full report supplied by the Shirley Institute, Didsbury, who carried out the tests.

Locality, etc.	*Variety.*	*Most frequent Hair-length in inches.*	*Mean Hair-length in mms.*	*Immaturity.*	
				% *Normal.*	% *Dead.*
Variety Test at Talodi (Nuba Mountains District)	Delrect I ...	$1\frac{3}{16}''$	23·8	54	3
	Webber 49 ...	Irregular	19·0	31	13
	Uganda S.G.15 ...	1″ full	20·6	39	16
	Wilds No. 1 ...	1″	19·8	44	6
	Pump Scheme ...	$1\frac{5}{16}''$	20·6	52	5
	Uganda S.G.26 ...	$1\frac{3}{16}''$	20·6	42	6
Variety Test at Bueda (Gedaref District)	Delrect I ...	$1\frac{3}{16}''$	20·6	24	27
	Webber 49 ...	$1\frac{1}{16}''$ (irreg.)	20·6	15	52
	Uganda S.G. 15...	Irregular	22·2	42	19
	Wilds No. 1 ...	$1\frac{3}{16}''$	23·0	36	34
	Pump Scheme ...	1″ full	23·8	50	24
Inspection plots at Torit (Mongalla District)	Delta Webber ...	1″ (irreg.)	19·8	49	30
	Pedigree Dixie ...	Irregular	18·3	35	42
	Columbia 40 ...	1″ (irreg.)	19·8	49	27
	Uganda S.G.15 ...	1″ full	20·6	45	25
	Uganda S.G.26 ...	1″ full	21·4	49	14
	Pump Scheme ...	$\frac{15}{16}''$	21·4	37	23
	Webber 49 ...	$\frac{13}{16}''$	19·8	32	31
"Controls", supplied by Shirley Institute	Arkansas... ...	$1\frac{1}{16}'' - 1\frac{1}{4}''$	26·2	34	19
	Egyptian Uppers	$1\frac{1}{16}''$	23·5	69	10

The remarks on these samples were :—

Talodi Group. "This group appears to be the most satisfactory from the point of view of maturity and regularity of staple. Webber 49 and Uganda S.G.15 are the worst on this score, which is a reasonable explanation of the poor appearance of the yarns spun from them."

Bueda Group. "Delrect is distinctly more immature in this group; Webber is very bad, yet the yarn was not so neppy as would have been expected, whilst the strength was good, probably on account of the relatively low hair weight per centimetre."

Torit Group. "The yarns spun from this group were generally neppy, and considered the worst on the whole, as regards appearance. The percentage of dead hairs is in most cases rather high."

The above results are of considerable general interest, referring as they do to samples grown in representative localities, in three of the most promising districts for rain-cotton growing in the Sudan.

The most striking feature of the results is, perhaps, their irregularity, but the relatively low percentage of dead hairs and relatively high figure

for " most frequent hair lengths " at Talodi, as compared with the other localities, stand out clearly.

The Arkansas " control " is interesting not merely as a basis for comparison, but from the point of view of its relatively very high mean hair-length.

The high percentage of " normal " hairs in the " Uppers " Control is doubtless connected with the fact that this sample would have been grown under irrigation, and not on an irregular rainfall.

The samples from Mongalla are handicapped by the fact that they represent the *whole* crop, including the last pickings which matured under very dry conditions, whereas those from Talodi and Bueda are taken only from early pickings.

7. Developmental Observations, Etc.

(*a*) *Routine Observations.*—These were carried on in order to obtain continuity of record, but on a reduced scale in view of pressure of other work.

(*b*) *Shedding Observations.*—A shedding trough was erected as in previous years, but the results obtained are unreliable owing to the death of several of the plants and the irregular incidence of disease amongst those that remained.

(*c*) " *Browning* " *of Cotton.*—Cotton grown in the Northern Sudan is sometimes noticeably dark in colour. This is often the case in the case of some of the Gezira cotton, but has been noted most particularly in the case of cottons on the Shambat Research Farm.

Some preliminary work has been undertaken in order to try and discover the cause of this darkening or " browning," and it is hoped that more time will be available in the coming season to allow of the matter being finally cleared up.

Browning takes place in both American and Egyptian cottons and is much accentuated by storage, but we have so far not been able to demonstrate that light or moisture have any direct effect, at our normal storage temperatures, on the rapidity of the change.

A single sample of cotton was divided into six portions and these portions were stored in the following ways :—

1. In a dark box (sealed to prevent entry of air).
2. In a dark box (not sealed).
3. In a jar of clear white glass (sealed).
4. Moistened and pressed in baling press before storage.
5. Pressed in baling machine, without moistening.
6. Wrapped up " loose " in a piece of white calico.

After 3½ months at the hottest period of the year at Shambat (March-June) the samples were opened and examined, but no differences in colour could be detected.

Other preliminary experiments made included the following :—

1. *Effect of Steam.* Test tubes were filled with Sakel cotton and exposed to steam in an autoclave for half an hour. These samples darkened in colour in a manner resembling the " natural " browning. A modified form of browning was obtained by keeping damp lint at 100° C. for 1½ hours ; a control tube of *dry* lint, also heated to 100° C., did not change appreciably.

2. *Constant Temperature of* 65° *C.* Test tubes were packed with cotton, either dry or moistened, and kept at 65° C. for several weeks. At the end of the period these samples, though they did not show any constant differences *inter se*, were all noticeably darker than other samples of the same cotton which had been kept at room temperature. One tube in the " moist " series was, however, made excessively damp and this did show a more decided darkening in colour.

None of the above preliminary experiments can be said to have given clear results, but they indicate that both high temperatures and high humidity can produce effects similar to those under consideration.

8. Cotton Experiments in the Southern Sudan (other than Standard Variety Tests).

As in the previous year a number of small scale experiments were planned by the Plant Breeding Section in collaboration with the Senior Inspector of Agriculture for the Southern Provinces.

At Yei, Kegelu, Torit and Meridi these were carried out entirely by the local Agricultural Staff, who were supplied with plans, instructions and materials from the Plant Breeding Section. At Talodi, Kadugli and Kirrippi they were run in conjunction with the Variety Test Plots by the Sudanese Staff of this section, under the supervision of the resident Inspectors of Agriculture.

All these experiments were visited by the Assistant Plant Breeder during a tour of inspection and detailed records and comparisons made.

The experiments were as follows :—

Preliminary " Observation " plots of New Varieties
at Kadugli and Talodi in Nuba Mountains District.
and at Kirrippi, Torit and Meridi in Mongalla.

Dates of Sowing Experiments
at Torit, Kirrippi and Meridi in Mongalla.

Manurial Experiments
at Talodi, Kegelu and Meridi.
Shading Experiment
at Talodi and Kirrippi.
Defoliation Experiment
at Talodi and Meridi.
Refilled Holes Experiment
at Kegelu and Yei. Mongalla Province.
Insect Exclusion Experiment
at Kegelu.
Single Rows of New Varieties
at Kegelu.

The following are brief details of the methods employed and the results obtained from these experiments :—

Preliminary "Observation" Plots of new Varieties.

These were single small plots (approx. $\frac{1}{8}$ feddan each) intended merely to give a visual indication as to whether certain new varieties would appear worthy of formal trials in a subsequent season.

Two new strains obtained from the Plant Breeder at Serere, Uganda, namely "Uganda S.G.27" and "Uganda S.G.29," were sown at each of the five places detailed above.

Germination of these particular experiments was poor in all the localities ; at Talodi, Kadugli and Torit it was so thin that very little could be deduced from inspection of the few plants that appeared, beyond the inference that both strains were capable of making vigorous, healthy and apparently fruitful plants with reasonably good lint.

At Kirrippi and Meridi the stand was much better and growth was strong, making attractive-looking and fruitful plots. Little difference could be detected between the two strains, both appeared well worth further trial. At Kirrippi they compared favourably (in apparent fruitfulness) with the Uganda N.17 strain in the adjacent Variety Test Plot, and at Meridi they stood out as definitely vigorous high yielding types, though inclined to a rather lax straggling growth (probably accentuated by the thin stand).

Dates of Sowing Experiment.

This experiment was repeated in three districts of Mongalla, identical plots being sown at Kirrippi, Torit and Meridi.

Three varieties were included and four sowings made of each on the same lines as the series described in last season's report, three "blocks" (each block containing a single row 70 metres long of each of the three varieties) being sown on each date.

The varieties sown were :—

Uganda S.G.29,
Delrect II,
Webber 49 strain 2,

and the sowings were made at approximately three weekly intervals from early June, covering the whole period during which the sowing of cotton in these districts is feasible. The actual dates at which the sowings were made, depending somewhat on local conditions and rainfall, varied a little from place to place.

The comparative results from all three stations are shown together below. In each case the average yield of the three rows of the first sowing of Uganda S.G.29 has been taken as the basis for the station and the yields of the other sowings of this strain and the other two varieties is expressed as a percentage of this figure. (Seed-cotton weights only are considered here, ginning out-turn is discussed later.)

Torit.	*1st Sowing.*	*2nd Sowing.*	*3rd Sowing.*	*4th Sowing.*
Uganda S.G. 29	100	52	30	18
Delrect II	66	52	26	7
Webber 49 Strain 2... ...	66	48	22	11

(The actual yield of the 1st sowing of Uganda S.G. 29 was at the rate of 460 rottles per feddan).

Kirrippi.	*1st Sowing.*	*2nd Sowing.*	*3rd Sowing.*	*4th Sowing.*
Uganda S.G. 29	100	88	93	50
Delrect II	68	72	47	22
Webber 49 Strain 2... ...	62	68	43	22

(The actual yield of the 1st sowing of Uganda S.G. 29 was at the rate of 920 rottles per feddan).

Meridi.	*1st Sowing.*	*2nd Sowing.*	*3rd Sowing.*	*4th Sowing.*
Uganda S.G. 29	100	87	50	14
Delrect II	52	32	9	2
Webber 49 Strain 2... ...	49	39	8	2

(The actual yield of the 1st sowing of Uganda S.G. 29 was at the rate of 1,000 rottles per feddan).

The general superiority of early sowing is clearly marked in these results and fully confirms the deductions made from last season's experiments. The actual date for the " first sowing " at each of the localities was as follows :—

Torit—June 8th.
Kirrippi—June 7th.
Meridi—June 14th.

Further confirmation is given by the results obtained by Mr. Turnbull (Inspector of Agriculture, Meridi), who found that June sowings gave consistently better results than July sowings in six different areas of Meridi district, with varying rainfall and differing soils, using Pump Scheme strain.

It may be stated with confidence that the most satisfactory results in Mongalla, in normal years, with all varieties of similar characteristics to those at present tried, will be obtained by sowing as early as possible after the rains have really set in (early to mid-June, or at the latest the end of June) in all districts.

The superiority in yield of the Uganda strain in Mongalla is also very striking. This superiority may have been exaggerated by the particular form of layout employed, whereby a vigorous type may establish an undue advantage in competition with smaller growing types alongside, but field observations did not suggest that this was occurring, except possibly to some extent at Meridi. Uganda S.G.29 is being included in the standard variety tests in Mongalla in the coming season in order that fuller information may be obtained as to its yielding powers.

The results are given above in terms of "seed cotton." The superiority of Uganda S.G.29 over the other types would be considerably diminished if the results had been taken as lint-yields, owing to the relatively lower ginning out-turn of that variety.

The yields of Delrect II are slightly, but fairly consistently, higher than those of Webber 49 strain 2, thus again confirming last year's results.

The following very brief notes for the three plots are given in order to increase the usefulness of the records :—

Torit.—Rainfall unusually poor and irregular, with long dry spells between short periods of excessive wet (only 2½ inches of rain fell between June 14th and July 23rd, whereas 9½ inches fell in ten days in mid-September). The *highest* yield obtained on this plot was 460 rottles per feddan. Blackarm was moderately severe, without marked varietal differences. Shedding very heavy in every case, but the Uganda strain was the least bad in this respect.

Kirrippi.—The first and second sowings here were handicapped by lack of early rains and it is probable that most of the seed sown on June 7th did not germinate until about the same time as the seed put in for the second sowing (July 1st). Rain was plentiful and well distributed after the 3rd sowing. The plot was satisfactory and gave a good stand and even growth, except at one side where some of the plants were partly shaded and others had been destroyed by elephants. The results given above have been corrected to compensate for this. Blackarm was moderately severe, shedding very heavy, and lodging bad (least so in case of Delrect).

Meridi.—The rainfall was adequate and fairly even throughout. Stand and growth were regular, the latter being vigorous in the case of early sowings and accompanied by bad lodgings, especially in the case of Uganda S.G. 29. The advantage of early sowing is most strikingly shown in this plot, where it appeared to be linked up with the question of Blackarm incidence. Blackarm symptoms, both stem lesions and angular leaf-spot, were general and extensive on all sowings, but whereas in the case of the earlier sowings the plants remained vigorous and appeared to have grown away from the attack, the later sowings were extremely badly damaged, many of the sympodia and often the head of the main stem being completely killed off. The fourth sowing was practically wiped out. Uganda S.G. 29 appeared to have suffered least. No other diseases or pests assumed major importance, though a white angular leaf-spot, caused by *Ramularia areola* was prevalent.

Manurial Experiment at Talodi.

A simple test was laid down at Talodi to give some indication as to whether the application of nitrogenous manures would produce marked increase in cotton yields in this district. Four small equal plots (1/10 feddan each) were sown with Pump Scheme Strain seed on July 2nd, two being treated with Sulphate of Ammonia at the rate of 2 cwt. per feddan, and two remaining untreated.

Slight extra vigour and a fresher green colour was reported in the manured plots at an early stage, but by December no visible difference could be detected between them.

No differences were shown up by flower counts, and the yield figures from the four plots, which were of good even stand and free from irregularities, gave only an insignificant increase in favour of the manured plots. Unfortunately a heavy fall of rain was reported to have caused considerable wash across the site soon after the application of the manure and may well have removed some or distributed it over the unmanured plots.

In the absence, however, of any indication of increased yield (the total yield from the experiment was actually below that of other plots near by) and in view of the obviously prohibitive cost of manuring on a commercial scale in this district at present it is not considered necessary to repeat the experiment with precautions against rain wash, at least as yet.

Manurial Experiment at Meridi.

Here an experiment was carried out to attempt to show whether the soil of this district was notably deficient in any of the three important manurial elements. A half feddan plot was divided into ten equal strips, two of which were devoted to each of the following treatments :—

(*a*) Sulphate of Ammonia at the rate of 200 rottles per feddan.
(*b*) Superphosphate at the rate of 400 rottles per feddan.
(*c*) Sulphate of Potash at the rate of 100 rottles per feddan.
(*d*) Complete manure (sulphate of ammonia, superphosphate and potash together at the above rates).
(*e*) Unmanured control.

Each strip was separated from adjacent strips by a single line of cotton which was cut out before picking commenced, and the outer strips were protected by belts of the same variety of cotton (Pump Scheme Strain).

All the manures were applied immediately after sowing, which was done on July 1st. The plot gave a good even stand of plants and was of fairly regular growth except for a marked but steady increase of vigour across the strips from No. 1 to No. 10. Growth was typical of the district, the plants being tall and vigorous. Lodging was not bad. Blackarm symptoms, both stem lesions and angular leaf-spot, were severe throughout and must have reduced the yield of all treatments appreciably, although the average

yield of the whole experiment was quite high (860 rottles per feddan). Notes made in August and September showed a distinct difference in rate of growth between the strips receiving ammonia (either alone or in the mixture) and those without added nitrogen, but by January these differences could no longer be detected.

The yields apart from a regular increase from strip 1 to strip 10, corresponding to the trend noticed in the vigour of the plot, show only comparatively small differences, and it is obvious that the manures have had no striking effect, the difference in yield between different treatments being no bigger than the range between the yields of the two strips of any one treatment. One of the unmanured strips happens to have given much the lowest yield in the plot, but as the other has given almost the highest little significance can be attached to this fact.

The actual yields, taking the average of the two strips of each treatment and considering the average of the two unmanured strips as 100, are as follows :—

No Manure	100%
Sulphate of Potash	107%
Superphosphate	112%
Ammonium Sulphate	113%
Complete Manure	115%

We may therefore say that none of the three manures tried alone or in combination is at all likely to produce increases large enough to be profitable in this district, and that the soil appears to contain sufficient of each element to grow very satisfactory crops without manuring at present.

Manurial Experiment at Kegelu.

This was an exact replica of the plot at Meridi described above, and is of special interest as it was thought possible that a deficiency of one of the essential soil elements might be the explanation of the very low yields obtained in this district in previous seasons.

The stand here was satisfactory and the soil fertility appeared even throughout. Clear differences in colour and rate of growth in favour of the strips receiving nitrogen were reported to be visible in the early stages, but by December no marked differences in vigour between treatments were distinguishable although where one of the strips receiving complete manure fell between an unmanured strip and a phosphate manured strip slightly higher vigour was noted for the complete manure. The yield of the unmanured strips was rather above that recorded for experiments in this district in the previous season but was still very poor, averaging only 420 rottles per feddan.

The average yield of the two strips of each of the manurial treatments on the basis of the unmanured strips as 100 was as follows : —

Unmanured	100%
Sulphate of Potash	99%
Superphosphate	103%
Ammonium Sulphate	117%
Complete manure	133%

The complete manuring, therefore, resulted in an increased return of 140 rottles per feddan and shows a marked increase over nitrogen alone, although phosphate or potash alone produced no increase. In all cases except that of the superphosphate application the yields of the two strips of any one treatment agreed quite closely so that the results should be fairly reliable. (The difference in yield between the two superphosphate strips was 20%).

While the increase obtained by complete manuring is quite appreciable it does not fully solve the problem of the low yields of this district inasmuch as it only brings the return per feddan up to 550 rottles. The plants receiving this manure, although slightly more vigorous, appear to have shed quite as freely as the unmanured plants and it is this very heavy shedding which reduces the large potential crop to such a meagre figure. In general the plants were tall (about one metre high) and had ample framework for carrying a crop but were full of blank nodes, lax, weak-stemmed, and inclined to lodge badly even without a heavy crop to bear them down. Blackarm symptoms were moderately severe, but not sufficient to account for the poor yield, and no other diseases or pests were serious. Rainfall was ample until almost the end of the growing season when it stopped somewhat earlier than usual, and was followed by brighter weather than that recorded in the previous season.

Shading Experiment.

At both Talodi and Kirrippi an attempt was made to demonstrate the effect on the fruiting of cotton plants of continuous shade, such as would result from an overcast sky as had been experienced so continuously at Yei and Kegelu in the previous season.

Unfortunately the shades designed were too small and too high above the ground effectively to shade only the same small patch of plants throughout the season, and there was no sharp distinction between the shaded and unshaded plants. It is proposed to repeat this experiment in the coming season at Shambat where the shade can be adjusted from time to time as required.

Defoliation Experiment.

This experiment was designed to demonstrate the effect of defoliation of cotton plants early in the season, and thus to obtain some idea as to the loss of crop which can be brought about by the defoliation caused by Blackarm.

Owing to the prevalence of Blackarm in both the districts in which this was carried out (Talodi and Meridi) it was not possible to obtain a completely healthy undefoliated " control " plot for comparison with the artificially defoliated plants, so that the comparison had to be

made between plants showing the normal partial defoliation produced by a moderately severe attack of Blackarm, and plants which had been completely defoliated artificially at about the time at which Blackarm was causing leaf-fall.

At Talodi no yield figures were taken. The whole plot on which the experiment was carried out was very stunted and growth ceased early so that in December it was almost impossible to judge the different fruiting of the defoliated and non-defoliated plants. However, in spite of the fact that Blackarm had been bad and consequent leaf-fall heavy on the undefoliated plants it was still possible to detect the artificially defoliated rows by their extra stunted condition, apparently heavier shedding, death of many of the sympodia, absence of top-growth and the production of weak late monopodial growth from below.

At Meridi the complete defoliation was carried out on two small strips of cotton (Pump Scheme Strain, sown July 1st) with intervening control strips of the same size. A stand count was made and yields taken from each strip separately, in addition to notes being made on the growth during the season (by the Inspector of Agriculture, Meridi).

The artificial (complete) defoliation was done on October 9th at the time when angular leaf-spot was attacking the crop and leaves were falling, the plants having already set a number of bolls. A subsequent note on October 21st records that the lower bolls which were well set before the plants were defoliated remained, but younger bolls at the top of the plant were shedding heavily. New leaves were being formed but flower development had been heavily checked. By January very little difference could be detected between the strips in the vigour and amount of late growth while it was too late to estimate differences in shedding. Blackarm had been quite bad (as already recorded in other experiments at Meridi) and had eventually caused shedding of most of the older leaves on the non-artificially defoliated plants.

Late monopodial growth was copious and angular leaf-spot general but no longer heavy.

The stand and soil fertility appeared sufficiently regular for the yield figures to be quite reliable. These were remarkable in the consistent big differences shown. For the first three pickings the yields of the artificially defoliated strips were roughly 50% only of the controls, for subsequent pickings the difference was even bigger. The final yields were as follows :—

Strip No. 1	...	Defoliated	...	7,363 grams
,, ,, 2	...	Control	...	26,894 ,,
,, ,, 3	...	Defoliated	...	9,140 ,,
,, ,, 4	...	Control	...	30,723 ,,

Thus the average yield of the two defoliated strips is only 28·6% of the average of the controls, showing a remarkable loss of crop which can only be explained on the assumption that while a cotton plant may compete successfully with a moderately severe attack of Blackarm causing continued gradual loss of leaves (which it can presumably replace progressively), the check caused by a sudden complete removal of foliage can never be outgrown.

It is probable that even badly infected leaves which are held on for a time, continue to function to some extent and help to bridge the gap until new growth is produced.

Refilled Holes at Yei and Kegelu.

Two large holes 2½ metres deep had been dug on experimental plots at each of these places in the previous season for soil sampling and were filled in again in the following manner :—

One hole at each place was filled in again with the soil that had been removed from it, as far as possible in the same order as it had been dug out (i.e. subsoil below and surface soil above).

The other hole at each place was filled up entirely with the grey loamy surface soil of the district.

Cotton was then planted over and around each hole at the normal sowing time this season with the intention of demonstrating the possible effects both of extremely deep cultivation and aeration of the existing soil and subsoil, and of the replacement of the possibly undesirable laterite subsoil with weathered surface loam.

The growth of this cotton was inspected in December. At both Kegelu and Yei the growth on the site of the hole refilled with its own soil was barely distinguishable from that of the surrounding plot and was similar to that already described for the Manurial Experiment at Kegelu. The hole filled in with surface soil at Kegelu gave slight extra vigour but showed the same heavy shedding of buds and bolls. At Yei the hole filled with surface soil bore plants distinctly more vigorous than those around, but again the growth was of the same leggy lax unfruitful type, shedding being very heavy.

We may therefore say that the nature of the subsoil is not the key to the problem of the poor cropping of cotton in this area.

Insect Exclusion Experiment at Kegelu.

Certain cotton plants growing in a small plot here were entirely covered with large nets on an iron framework, thereby effectively excluding all insects, and also introducing a shading effect.

In December their growth was compared with that of uncovered " control " plants of the same variety (Pump Scheme Strain) nearby, with the following deductions :—

The exclusion of insects had made no difference to the nature of growth or cropping (insect pests had had no obvious effect on the uncovered plants).

The shading had resulted in a taller lusher growth, lengthening the internodes while actually reducing the total nodal production of both main stem and sympodia, without strikingly modifying the fruiting.

The total number of bolls of all sizes held on the plants when seen was roughly the same (12-15) in the two cases, so that the percentage shedding was lower in the case of the shaded plants, although the unnetted plants, with more blank nodes, carried the same crop.

Single Rows of New Varieties at Kegelu.

Short single rows of each of the following varieties were sown merely to see whether they would react in any markedly different way to the special conditions of this district.

Parnell's U.4 (imported from Barberton).
X.A.129 (a new type of American cotton from Shambat).
Gossypium herbaceum (from Afghanistan).
Gossypium obtusifolium (var.) (originally from Siwa Oasis).
Tanguis (Peruvian Cotton).
Ishan (Indigenous Nigerian Cotton).

A row of Pump Scheme Strain (American Upland) was grown between each for comparison. The following notes were made on the rows in December :—

Parnell's U.4 appeared to crop a little better than the control but the type of growth was the same.

X.A. 129 was more dwarf and erect in habit and appeared more fruitful than the control but was shedding nearly as much.

G. herbaceum was dwarf and late and showed no promise.

G. obtusifolium produced big plants but shed almost completely, giving no crop.

Tanguis grew vigorously but was almost destroyed by Blackarm and bore no crop whatever.

Ishan looked very promising. It was late in starting to crop but was producing a good crop of bolls and not shedding to anything like the extent of the control or the other types here when seen in December. It was not then showing any sign of suffering from drought but was healthy looking (Blackarm infection was slight) leafy and still growing and flowering, while the control was drying off.

Should cotton growing and experiments be resumed in this district in the future, Ishan should certainly be tried out on a larger scale, together with, perhaps, Parnell's U.4 and X.A.129.

(Included by courtesy of the Uganda Government.)

UGANDA

REPORT OF THE COTTON BREEDING SECTION DEPARTMENT OF AGRICULTURE SEASON 1930-31

BY

G. W. NYE, *Cotton Botanist,* AND H. R. HOSKING, *Assistant Cotton Botanist.*

SUMMARY.

(*a*) BUKALASA.—The general weather conditions were dry, rainfall being below average, especially during the latter part of the year. Dry spells in July caused difficulties with regard to planting, and in November, December and January caused heavy boll shedding and curtailment of the flowering curve, which resulted in a rapid crop. Angular leaf spot was widespread, but weather conditions were favourable and plants were able to throw off the disease before the development of the blackarm stage.

In the breeding plot special attention was paid to resistance to angular leaf spot and to the production of an improved type of plant. One strain, B.31, showed complete resistance to the disease while several others—among them being three families of Acala—showed only slight susceptibility. Several lines—among them B.42 and B.45—showed excellent erect habits, were storm resistant and early and quick maturers. Re-selections from U.4 were disappointing and showed no outstanding characters. Selections made from local cottons showed the greatest promise, and although it will take a considerable time to fix any desirable type, improvements in both quality and yield should be obtained.

An investigation into the effect of the weight of individual seeds from the same sample on the yield of the crop produced showed that although the seed weights differed by 100% yet no real differences in yield or quality of the subsequent crop were observed.

The shedding experiment was conducted at Bukalasa and showed total shedding of buds and bolls to be 83% of the potential crop as compared with 89% at both Kampala and Serere last season. Very few of the buds and bolls shed were shed as a direct result of insect or disease damage.

Variety Trial.—The most outstanding result of the variety trial was the failure of U.4 to repeat its supremacy over other varieties of last season. S.G.27, S.G.27.15.13 and Local were all significantly higher yielders than U.4 and definitely superior in quality. None of the Serere strains showed any superiority in yield over local cotton, but as regards uniformity of lint they are a definite improvement. S.G.23.8 did very badly owing to its late maturing character which caused its flowering peak to coincide with the period of heavy boll shedding brought on by the dry weather. U.4 produced a significantly higher proportion of stained and low grade cotton than any other variety in the trial except S.G. 27.15.13.

Increase plots of U.4, S.G.23.8 and S.G.27.15.13 were successful and produced high yields.

Insect pests and diseases caused comparatively little damage. Syagrus caused a considerable loss of young plants, but apart from that pest and a few aphides no damage was observed. Jassids and stainers were non-existent until the main crop had been harvested. Angular leaf spot was widespread, but practically no blackarm occurred.

Results of the first season at Bukalasa are very encouraging, several promising strains and types have been isolated, and plenty of material for selection is available in the surrounding native crop. Definite signs of deterioration in the Buganda crop are present and the improvement in quality is becoming a matter of urgency.

(*b*) Serere.—The season was a successful one, expecially when compared with last season's failure on account of blackarm. Weather conditions were generally favourable and despite rather high rates of shedding a good crop was harvested. Angular leaf spot was widespread, as at Bukalasa, but here again weather conditions were such as to prevent the development and spread of the blackarm stage. Angular leaf spot spread rapidly until the middle of October, when the rainfall fell to below normal and the disease was checked. During the dry spell after September, jassids appeared in very large numbers and caused considerable damage to certain of the strains.

Marked differences were noted in respect to resistance to angular leaf spot and jassids. S.G.129, a single-plant selection made in the Usuku area in the previous season, showed great resistance to angular spot. U.4.4.2 from Barberton grown in pedigree lines, was resistant to both jassid and angular leaf spot to a considerable extent. Several promising re-selections have been made from this.

A comparison of U.4 once grown in Uganda with U.4 seed as originally obtained from Barberton showed that no deterioration has

occurred, as U.4 once grown gave the higher yield, although this might quite possibly have been merely due to its better germination.

In the variety trial at Serere, as at Bukalasa, the superiority of U.4 over our existing strains was not in evidence this season, and although no strains gave higher yields, four were equal to it. S.G.23.8 failed badly owing to jassids. U.4 also produced a higher percentage of fifi cotton than most of the other strains. Examination of cotton from this trial showed very high lint indices, especially when compared with those given last year, and also showed that the same varieties grown at both Bukalasa and Serere are from 1–2 mm. longer in staple when grown at the former station than at the latter.

The variety trials at the eight outside centres were disappointing as in only two of them were the results significant. The general results indicated that S.G.27 and U.4 were the highest yielders, while S.G.23.8 was the lowest, owing mainly to its jassid susceptibility.

The outstanding feature of the season was the failure of S.G.23.8 owing to its great susceptibility to jassids. This is unfortunate, since the spinning tests have shown this strain to produce stronger yarn than any other Eastern Province selection. During the coming season, it is hoped to make some crosses between S.G. 23.8 and the jassid-resistant Cambodia from South Africa.

Increase.—S.G.29 was grown for the first time in general distribution, the whole of Kadunguru gombolola being planted with it in addition to the Mulondo Seed Farm area. The Seed Farm area produced an excellent crop and the whole scheme worked very satisfactorily. S.G.23.8 was grown as the main crop at Serere and yielded well, but owing to its jassid susceptibility it is being discarded.

The Mulondo segregated area showed an average yield of 612 lbs. seed cotton per acre, with a total area of 402 acres. Both these figures are a vast improvement on the previous season. The scheme can now be looked upon as a definite success.

The strain S.G.29 has now reached the seventh stage in the multiplication scheme. Under the present system it can be expected to be in general cultivation throughout the whole Eastern Province in another eight seasons.

The one-quarter acre trial plots were repeated, S.G.23.8 replacing S.G.29, and N.17 remaining. The total results showed no differences between the two strains, but taken district by district the results gave indications of differential varietal reaction to environment.

The continuous planting experiment was repeated and again showed the value of applications of kraal manure for retaining the fertility of old plots.

Reports by brokers and spinners were received from the 1929–30 samples. S.G.23.8 was the outstanding variety on account of its Lea strength.

General.

The establishment of two centres for cotton breeding became an accomplished fact by the opening of the new cotton laboratory at Bukalasa in July. It is intended that the new centre should serve the elephant grass zone consisting mainly of Buganda Province and Bunyoro, while Serere will continue to serve the short grass areas of the Eastern and Northern Provinces. The boundary between the two zones is approximately the River Nile. The laboratory and a house for the Cotton Botanist were completed in September, the Cotton Botanist transferring from Serere to Bukalasa in July in time to supervise the planting of the breeding plot and other cotton experiments. At Bukalasa three two-acre plots have been allocated for breeding plots and three plots of the same area for the variety trials. Each will be under cotton one year in three while for the other two years they will be under permanent cover crops so as to avoid soil erosion, and soil exhaustion by the removal of other crops. Suitable segregated plots have also been allocated for increase plots; these will be used for increase of maize and groundnuts when not required for cotton. It is hoped that the opening of a breeding centre in Buganda will result in a rapid improvement of the crop which appears to have been undergoing rather steady deterioration in recent years. No work has hitherto been done on the improvement of cotton in the elephant grass areas.

Staff.

Mr. H. R. Hosking, Assistant Cotton Botanist, is stationed at Serere to carry on the breeding work in that zone. He was at Serere throughout the season until January, when he proceeded on home leave. Mr. E. A. Ruck, Plantation Manager, carried on the work until the end of March.

The laboratory staffs at Bukalasa and Serere were augmented by the appointment of two Makerere-trained assistants. Both of these have done much of the routine work of combing, measuring, etc., which formerly had to be done by the European staff; they have carried out their work in a thoroughly satisfactory manner and have both warranted their appointments.

Report.

This report is divided into two sections: (*a*) Bukalasa, and (*b*) Serere.

BUKALASA.

Meteorological.

Prior to planting, the rainfall was considerably below average and during July, which is normally the best planting month in this area, a prolonged dry spell of nearly three weeks was experienced which had a bad effect on early planted cotton and resulted in the main crops being planted late. Rainfall in August and September was average, but after this very little rain fell, and for the last three months of the year the rainfall was five inches below the average for the last ten years. This dry weather was undoubtedly responsible for the non-appearance of blackarm except in one or two isolated cases. From November onwards hot and dry weather resulted in the rapid ripening and opening of bolls and in very heavy boll shedding. The crop was completed rapidly and no second crop of flowers was produced. In January a considerable number of bolls ripened too quickly and opened prematurely, with the result that a considerable amount of immature lint was produced ; this was specially the case with late maturing strains such as S.G.23.8.

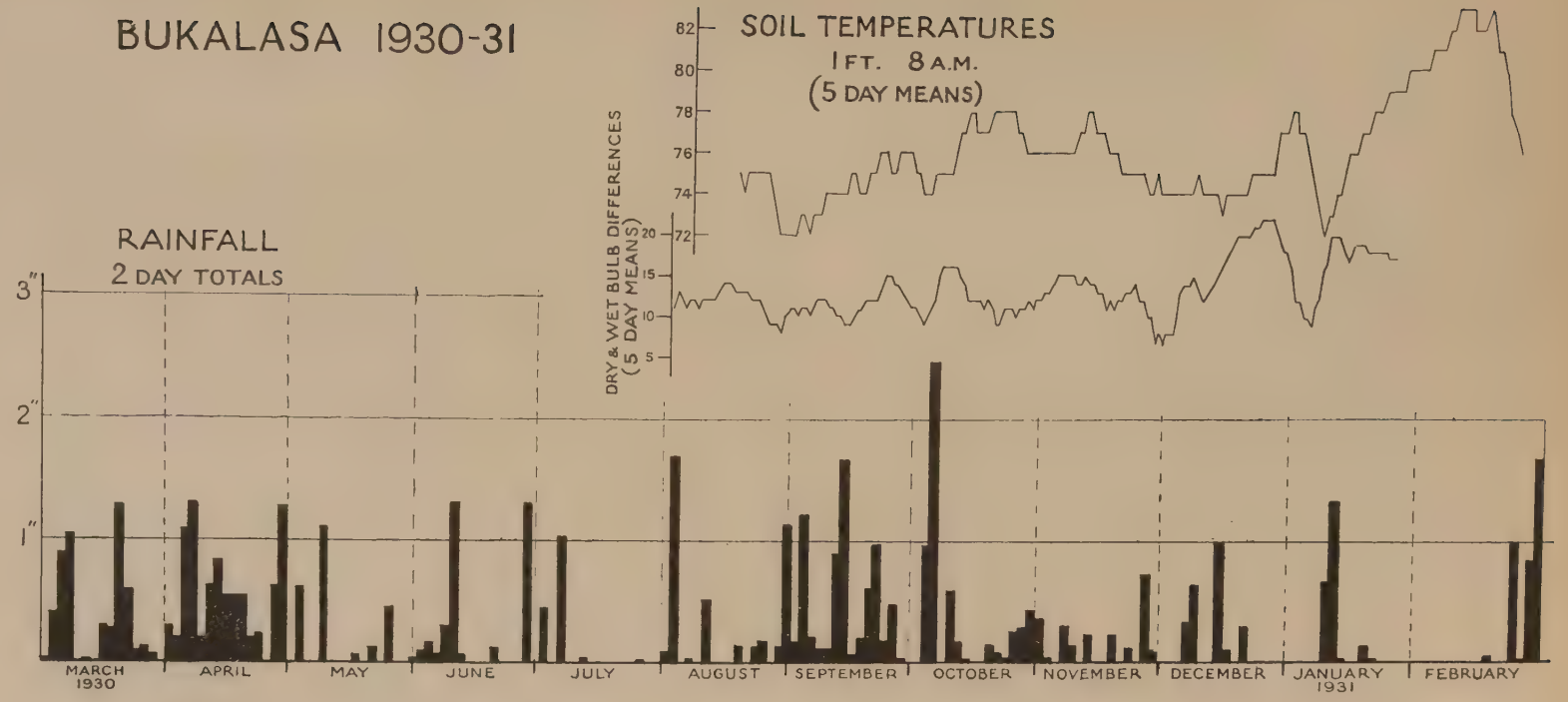
The soil temperatures are interesting when compared with those of Serere as they are considerably lower and generally well within the optimum for development of blackarm, and yet no blackarm was in evidence.

A small hailstorm was experienced at Bukalasa in November accompanied by high wind ; fortunately the breeding plot escaped the full force of this storm, but sufficient force was experienced to be useful in determining storm-resistant strains, some varieties being laid almost flat, while others, e.g., B.42 and B.45 were unaffected.

Breeding Plot.

The block of land selected for breeding work was virgin soil with a distinct slope. The soil was deep and very little wash was experienced during the season. The block has been divided into three sub-blocks, only one of which will be in use in any one year ; the other two will be under permanent cover crops.

New Selection Series.—This consisted of 81 twenty-plant rows, all of which were Upland types, including fourteen lines from the original " B " series, twenty new lines which had been selected by Mr. Stephens in 1928–29 in the surrounding district, the rest being Serere lines, including ten from U.4. The whole plot was sown on July 24th, the soil being dry and very rough. Two seeds were sown per hole where


BUKALASA 1930-31
SOIL TEMPERATURES
1 FT. 8 A.M.
(5 DAY MEANS)
82
80
78
76
74
72
DRY & WET BULB DIFFERENCES
(5 DAY MEANS)
20
15
10
5
RAINFALL
2 DAY TOTALS
3"
2"
1"
MARCH 1930
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY 1931
FEBRUARY

seed was available and a spacing of 5 feet by 2 feet was adopted. The weather was so dry after planting that hand watering was necessary on two occasions. The original stand was 86%. Resowing was done August 6th and this gave a final stand of 94%.

Owing to the importance of blackarm disease as a limiting factor in yield in certain years, very special attention was paid to the spread of and resistance to the disease on the breeding plot. Weekly counts of leaf spot infection were made until the plants became too large to allow of accuracy. The table below gives the figures obtained from these counts. The disease varied greatly in intensity according to variety and definite degrees of resistance were observed. For instance, three families of S.G.99 (Allen var.) gave 100% infection within the first two weeks of the disease becoming evident, while the line B.31 showed complete resistance throughout the season, not a single leaf spot being observed at any time. The U.4 families showed no particular resistance. Selections from S.G.88 (Acala) and families of S.G.35 showed considerable resistance as well as most families of the "B" series.

TABLE I.

Showing Spread of Angular Leaf Spot.

Date.	*Number of Plants infected.*	*Percentage of plants infected.*
September 12th	17	1·14
„ 20th	81	5·45
„ 26th	154	10·40
October 2nd	222	14·90
„ 9th	315	21·10
„ 16th	619	41·60
„ 23rd	818	55·00
„ 30th	926	62·50
November 6th	986	66·50
„ 13th	1,037	69·50

TABLE II.

Showing Percentage Number of Plants Infected in Groups of the more Important Families.

	Families.							
	S.G.85	U.4	S.G. 99	S.G.27	S.G.29	S.G.88	S.G.35	S.G.23·8
Number of lines ...	9	11	3	6	4	3	2	3
Percentage number of plants infected A.L.S. on October 31st	68·4	78·6	100·0	85·0	90·0	29·5	45·0	98·5

Except for a few plants in the S.G.99 families and in U.4 families, no blackarm occurred at all.

The general habit of the crop in Buganda is very straggling; the plants have long monopodia which at the time of bolling for the most part lie on the ground and the main stems themselves are liable to lodge very easily after heavy rains and high wind. The consequence of this is that a large amount of cotton is spoiled each year by becoming mud splashed and generally soiled. Amongst the local crop are numerous promising types and several of these were included in this season's new selection series. Five lines showed great improvement in habit, namely. B.32, B.42, B.45, B.54, S.G.88.2 and 4 and U.4.9. These all gave erect storm resistant plants with monopodia, which were short and erect.

The flowers were counted and tied with sisal fibre daily, each flower on selfing being labelled showing the date of opening. Bolls from each plant were harvested separately and only those which had been selfed, were harvested. Observations were made on five bolls per plant and length measurements made on ten seeds per plant, each seed from a different boll. The measuring was done by both tuft and halo methods—the former proving to be the more satisfactory one, especially as it bears a direct relation to brokers' lengths.

The most promising of the strains in this series were several of the "B's" on account of uniformity and yield. The line B.32 produced enormous quantities of flowers, its flowering rate reaching 4.0 flowers per plant per day, but its bolls were very small and the lint short and very harsh.

B.31 showed promise as a type resistant to blackarm. The yield was not good, but the quantitative boll characters and the staple were satisfactory.

B.42, B.45 and B.54 were all very similar in habit. The first two appeared to be quick and early maturing types; their flowering curves were very steep both in the ascent and descent; in addition, B.45 gave a lower boll shedding rate than any other line.

The U.4 families were disappointing, most of them producing a large number of flowers, but suffering badly from boll shrivelling. The staple was very short and the lint harsh. Only a few plants came up to the required lint standard and these have been selected for further trial.

The families of S.G.27 and S.G.29 did comparatively well and gave evidence that their lint characters are now fixed. The S.G.23.8 group did not live up to its former promise and suffered badly from angular leaf spot.

S.G.85 lines were very disappointing after the excellent yield given by S.G.85 last season at Serere; nine families were grown and

not one gave anything approaching the yield of the parent row and the lint characters were well below standard.

The most promising material in this series consists of the strains B.37 and B.57 which were selected locally—they are far from being true to type, but several years' selection should enable suitable types to be envolved. Reports on the Buganda crop indicate that it is falling off in quality and it is now a matter of urgency to produce a type suitable for this part of the country with a uniform style of lint. It is possible that one of the Serere improved strains will be able to be used as a stop-gap, but a real improvement in yield and quality is not expected until selection work has proceeded at Bukalasa for a considerable period.

TABLE III.

Showing some of the Characters of some of the most Promising Strains in the New Selection Series.

(The figures given are the means of the row in each case.)

Strain.	*Flowers produced.*	*Bolls harvested.*	*Percentage bolls shed.*	*Seeds per boll.*	*Motes per boll.*	*Lint weight per boll.* (gms.)	*Lint Length.* (mm.)	*Lint Index.*	*Ginning Outturn.*	*Remarks.*
B.16 ...	83	26	69	32·9	1·9	1·73	32·5	5·3	30·5	Most promising of the B. series.
B.31 ...	85	30	65	31·4	2·8	1·61	31·5	5·1	31·6	Resistant to A.L.S.
B.37 ...	103	43	58	32·9	1·9	1·79	32·2	5·4	30·4	Erect bushy type, good yielder.
B.42 ...	85	30	65	33·3	2·4	1·81	32·2	5·4	33·0	Erect quick maturing type.
B.45 ...	48	24	50	33·5	2·5	1·80	29·7	5·4	32·4	Low shedder. Erect & quick maturing type.
B.54 ...	81	34	58	31·9	1·9	1·43	31·7	4·5	28·6	Erect habit.
S.G.88·1	68	26	62	33·4	2·1	1·86	32·8	5·6	31·9	Acala var.
S.G.96·7	80	26	67	32·5	2·5	2·02	31·6	6·2	31·8	Re-selection from S.G.27 (S.G.27.15.13. 5.7.)
U.4·1 ...	82	35	58	28·8	2·7	1·58	29·8	5·5	33·7	One of the best of the U.4 selections.
U.4·9 ...	62	28	55	29·4	2·6	1·79	27·6	6·1	35·3	Good habit but short stapled.

Pedigree Line Series.—This is the next stage after the new selections, each line consisting of two rows of twenty-five plants each. The spacing is 5 feet by 2 feet and on either side of each line two rows of

local cotton are planted for general eye comparisons. All plants are selfed except any that may be rejected before flowering commences. Observations are made similar to those in the new selection series.

*U.*4.4.2.—This was obtained from Mr. Parnell at Barberton. The plants were fairly short and erect with many sympodia. Infection by angular leaf spot was slow and only 33% of the plants became infected. Flowering rates were high, but boll shedding was heavy and the resulting yield disappointing. The staple was short and the lint harsh and well out of our normal class. The following were the main quantitative characters :—

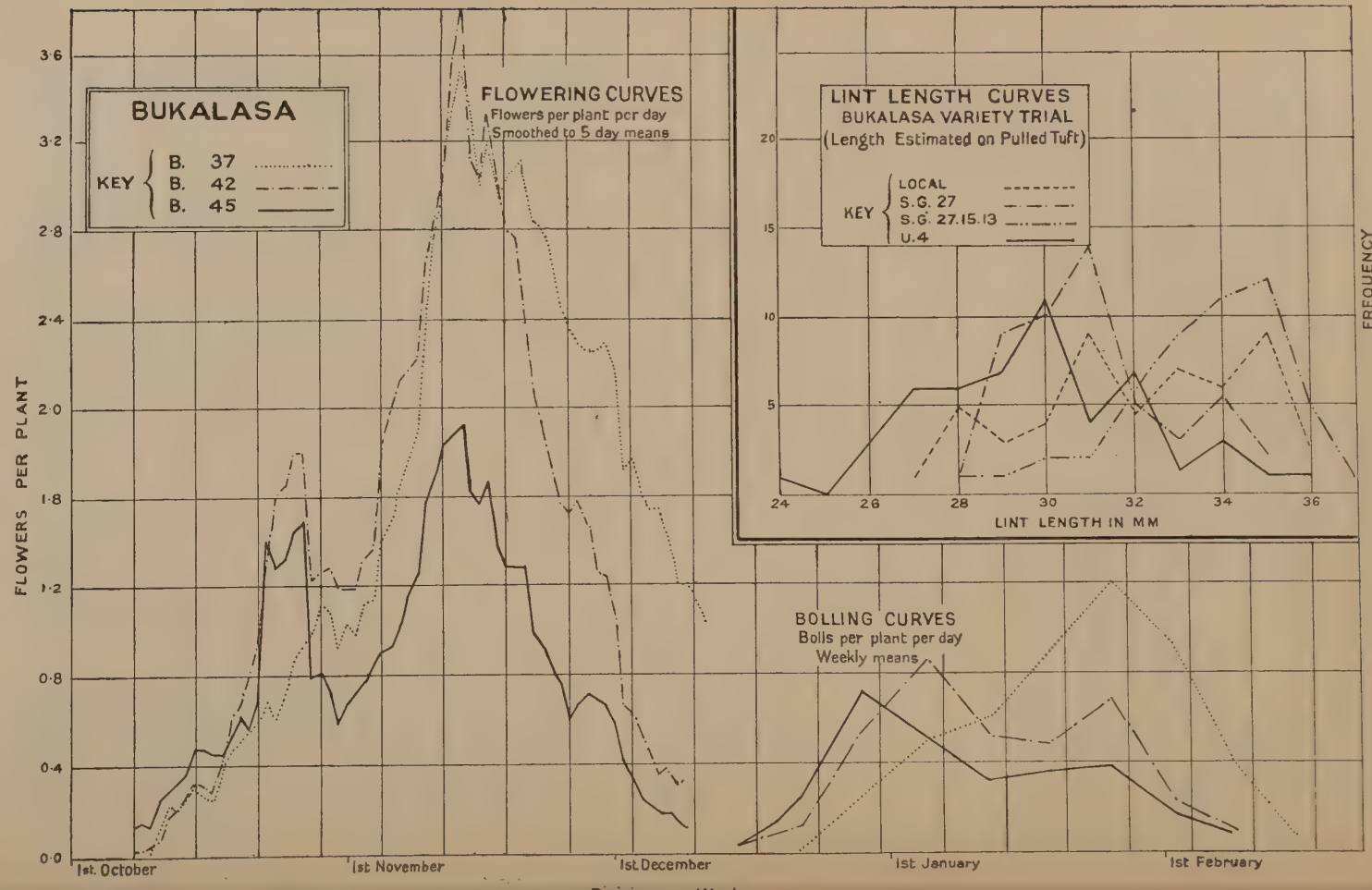
Seeds per boll.	*Motes per boll.*	*Lint weight per boll gms.*	*Lint length mm.*	*Lint Index.*	*G.O.T.*	*Bolls per plant.*
30·2	2·3	1·79	27·1	5·92	36·7	30·2

The quality of lint is unsuitable for this country, but selections of long silky linted plants were made for trial next season.

Wild's No. 1.—The seed of this was obtained from the Sudan. It suffered very badly from angular leaf spot and blackarm and hardly a sound boll was produced. A few selections were made from those plants showing any resistance to the disease.

Flowering and Bolling Curves.—These curves were taken from three strains in the breeding plot and are of interest as they depict three distinct types. B.42 and B.45 both have very similar branching habits with practically no monopodia ; this is shown up by the rapid curtailment of the flowering curves which are nearly identical in shape in each case. B.42 is a heavy flowerer but at the same time a heavy boll shedder, while B.45 has an abnormally small flowering curve and a low rate of boll shedding, the resulting crop being very nearly the same for both lines. The main peak of B.45 is about a week earlier than that of B.42 but both strains are very quick maturing. B.37 is a heavy cropper, but while its flowering reaches the peak at the same time as the other two strains its bolling peak is three weeks later than that of B.42 and four weeks later than B.45. B.37 appears to react somewhat differently to external conditions in the early stages of development as it produces practically no peak at the middle end of October, whereas both the other strains give a very pronounced one.

Lint Length Curves.—These curves were taken from samples of the Bukalasa Variety Trial, the lengths being estimated by the " pulled


BUKALASA
KEY
B. 37
B. 42
B. 45
FLOWERING CURVES
Flowers per plant per day
Smoothed to 5 day means
FLOWERS PER PLANT
3·6
3·2
2·8
2·4
2·0
1·8
1·2
0·8
0·4
0·0
1st October
1st November
1st December
1st January
1st February
Divisions in Weeks
LINT LENGTH CURVES
BUKALASA VARIETY TRIAL
(Length Estimated on Pulled Tuft)
KEY
LOCAL
S.G. 27
S.G. 27.15.13
U.4
20
15
10
5
24
26
28
30
32
34
36
LINT LENGTH IN MM
FREQUENCY
(No. of Seeds Measured)
BOLLING CURVES
Bolls per plant per day
Weekly means
Uganda Survey Dept

tuft " method. The mixed state of Local cotton and U.4 as compared with the two Serere strains S.G.27 and S.G.27.15.13 is clearly shewn.

Delrect.—This was obtained from Mr. Bailey in the Sudan. The strain was badly attacked by angular leaf spot and blackarm and owing to its glabrous leaves it would probably suffer badly from jassids (see Report for Serere). Bud and boll shedding were high and a very small yield was obtained. The outstanding characters of this strain were the high weight of lint per boll and high lint index. The plants were small and their habit was not so erect as when grown in the Sudan. The following characters were recorded :—

Seeds per boll.	*Motes per boll.*	*Seed weight per boll. gms.*	*Lint weight per boll. gms.*	*Lint length mm.*	*Lint Index.*	*Ginning Outturn.*
32·6	2·8	3·99	2·01	28·2	6·2	33·4

*S.G.*27.—This was included in the pedigree lines as no increase plot was available and a supply of Bukalasa-grown seed was required. It yielded comparatively well, but was far from uniform. Angular leaf spot infection was heavy, but little evidence of blackarm attack was observed. Several promising re-selections were made :—

Seeds per boll.	*Motes per boll.*	*Seed weight per boll gms.*	*Lint weight per boll gms.*	*Lint length. mm.*	*Lint Index.*	*Ginning Outturn.*
32·8	2·1	3·64	1·69	29·4	5·18	31·7

None of this season's pedigree lines warrant further increase except " selected S.G.27 " on account of its good showing in the variety trial. One other line, S.G.96, was discarded on account of its splitting into khaki linted forms.

Reference Plot.—The following varieties were grown in small 30-plant plots for reference and selection purposes. They were all grown for the first time at Bukalasâ :—

Columbia 44 (from the Sudan).—This made vigorous growth but produced short and harsh lint.

Cambodia.—Tried for jassid resistance but not a true test as jassids were not present in large numbers at Bukalasa this season. Angular leaf spot was severe and several plants developed blackarm.

Webber and Bancroft.—Both these produced very poor crops.

Allen.—This variety did very well at Serere last season but this year it went down badly to blackarm and no plants worth selecting were observed.

Arizona.—Seed came from N. Rhodesia in 1929. Several good yielding plants were selected.

Meade, Acala, and Kasch.—None of these produced a crop worth harvesting.

G. Brasiliense (Segamwenge).—A native cotton probably introduced into this country by traders many years ago. A typical kidney cotton, perennial, and very susceptible to angular leaf spot and blackarm.

Mixed Plot.—A 1/60th acre plot was planted with a mixture of seed consisting of all the Upland varieties and strains available. Plants were allowed to intercross freely. The F.1 will be planted next season and again allowed to cross, after which the F.2 will be planted and selection will commence within the mass of plants obtained.

Seed Size Investigation.—Last season where blackarm was bad in Teso and Lango a large proportion of the seed produced was very small and shrivelled. Owing to the possibility of blackarm being serious in a majority of years and to the possibility of the small seed giving rise to weakly plants a preliminary trial was laid down to test the progeny of the small seed as compared with that from normal sized seed. A sample of ordinary commercial seed was taken and the seed was sorted out into large and small. The small seed was very shrivelled and weighed just over half the weight of the normal seed.

Rows of 30 plants each were sown in random pairs, there being four rows of each seed type. Weekly growth measurements were made from the time of germination. The germination of the normal seed was slightly better than that of the small seed but the latter germinated more rapidly, presumably owing to water being more easily absorbed through their slightly fuzzed and weaker seed coat. The growth rate was about the same, but the normal seed produced slightly taller plants on the average, although it was not possible to distinguish this by eye. Daily flower counts were made on each row, the balance of flowers being in favour of the normal seed. The final yields showed no significant difference, although here again the normal seed was the better. Analysis of the seed cotton showed no appreciable differences ; the seed weight of the small seed reverted to the " normal " again. The lint length appeared to be definitely in favour of normal seed, but the small seed produced a staple fully up to the required standard.

The results of this preliminary trial indicate that the smallness of the seed does have some very slight effect on the subsequent crop, but not enough to warrant any measures being taken to separate the small from the large seed before planting.

TABLE IV.

SUMMARISING RESULTS OF SEED SIZE INVESTIGATION.

Seed Type.	*Weight 100 seeds of original sample. gms.*	*Germination percentage*		*Mean Flowers per row.*	*Mean Yield per row in lbs.*	
		Laboratory	*Field (3 seeds per hole).*		*Total.*	*% Fifi.*
Normal Seed ...	10·19	73%	89%	479	9·47	13·6
Small Seed ...	5·68	61%	81%	405	7·61	15·9

	Lint Length mms.	*Lint Index.*	*Seed Wt. per 100 seeds gms.*	*Ginning outturn.*
Normal Seed	31·57	5·21	11·65	31·0
Small Seed	30·31	5·39	11·04	32·6

INCREASE PLOTS.

Three small bulk increase plots were grown with seed from Serere in order to provide a supply of acclimatised seed for trial under Bukalasa conditions next season.

*U.*4.—A quarter-acre plot of this variety was grown and yielded at the rate of 678 lbs. per acre. The percentage of fifi given on this plot was 10.8. The type of plant was very variable and a few selections were made in the plot.

*S.G.*23.8.—A half-acre plot of this strain yielded at the rate of 666 lbs. per acre with 7.8% fifi cotton. The picking peak was two weeks later than those of U.4 and S.G.27.15.13, and the consequence of this late maturing character was to produce a large amount of immature cotton owing to the dry spell which exerted its greatest effect on the later bolls.

*S.G.*27.15.13.—A quarter-acre of this strain was planted on a very poor, stony, shallow-soiled plot (the only one available) the consequence being that over 80% of the plants were very stunted and a yield of only 467 lbs. per acre was obtained.

The results from U.4 and S.G.27.15.13 are interesting as they clearly show that no reliance can be placed on figures obtained from single non-adjacent plots. Were the figures from these increase plots taken as being correct as far as the comparison of the two varieties is concerned U.4 would immediately be taken as being a far higher yielder than S.G.27.15.13, but the results of the variety trial on the same farm shows that actually S.G.27.15.13 is a significantly higher yielder than U.4.

No medium bulk or bulk plots were grown at Bukalasa this season.

Variety Trial.

The only plot available for this experiment was one which had been used for a similar purpose in the previous season and which had given an average yield of under 30 lbs. per acre. There was a fairly steep slope on the plot and a gravelly outcrop at one top corner. The wash was rather bad after heavy rains, but was checked by running the tractor and subsoiling plough along the six-foot alleys between the plots at right angles to the slope.

Owing to very dry weather planting was later than usual, the actual date being July 31st after rain on the previous day. At the time of planting the soil was very open owing to a large amount of undecayed vegetable matter which had been dug in too late.

The lay-out was in the form of a seven Latin square with the following strains under trial :—

Local cotton (consisting of a mixture of Allen, Sunflower, Black Rattler, Nyasaland and several other types).

N.3/5.—From a selection made at Bukalasa in 1923/24 in a crop of Nyasaland Upland.

S.G.27.—From Serere.

S.G.29.—The Serere strain but once grown at Bukalasa.

S.G.23.8.—The low shedding strain from Serere.

S.G.27.15.13.—From Serere.

U.4.—From seed once grown at Serere.

The plots were 34 feet by 32 feet, giving nine rows of 18 plants each for each plot at a spacing of 4 feet by 2 feet. The plots were separated by six-foot alleys and two rows of cotton surrounded the whole block.

Six seeds were sown per hole, but two re-sowings were necessary. In the final count both S.G.29 and N.3/5 gave significantly lower germinating capacity than any other strain—these were the only two strains in the trial whose seed had originated from Bukalasa and the very poor germination is accounted for by damp storage and the very poor crop of the previous season.

The final percentage stands were as follows :—

Local	*S.G*.23·8	*S.G*.27	*S.G*.29	*N*.3/5	*U*.4	*S.G*.27.15.13
88·0	84·5	84·5	64·6	66·2	86·9	83·7

The plants made very slow progress and several angular leaf spot infections were observed on September 17th ; at this period the

plants were so under-developed that it was possible to make weekly counts of infection until the middle of October by which time nearly 80% of the plants were infected. There was no varietal difference observed either in intensity of attack or in the number of trees infected. The plots at the top end of the block showed less infection, probably due to better drainage.

At the same time the root grub Syagrus made its appearance and caused considerable damage, a rough count indicating that at least 4% of the crop had been killed by this pest, apart from numerous plants which were attacked and damaged but which recovered later. Up to the end of November very little varietal difference was observed except that S.G.27 seemed to be definitely ahead of other varieties, especially in flowering rate, while S.G.23.8 was definitely the most backward. At this stage the development of the plants was very meagre and a low yield seemed unavoidable; the root system was very poor and it was found that an impervious clay layer exists on this block about eight inches below the surface and as soon as the roots reached this they grew laterally instead of downwards.

Drier conditions in October with rain at the right time caused a great improvement in the appearance of the crop. Picking commenced on December 23rd and continued at weekly intervals until February 24th, when the crop was finished. The rapid ending of the crop was brought on by the very dry weather in January and February which caused an enormous quantity of boll shedding. The picking curves of all varieties were very similar except in the case of S.G.23.8, whose picking peak was a fortnight later than that of any other variety.

The following table summarises the results :—

TABLE V.

Variety.	*Mean Yield per plot in lbs. (1/40th acre).*	*Yield expressed as percentage of mean.*	*Percentage Fifi (stained) and low grade cotton).*
S.G.23·8	15·54	96	9·1
S.G.27	18·49	114	10·5
U.4	14·36	89	12·6
N.3/5	15·09	93	10·9
S.G.27.15.13	17·27	106	11·6
S.G.29	14·09	87	11·1
Local	19·02	118	9·1
Mean	16·20	100	10·7
S.E. of the difference	1·45	8·9	0·74

Taking the figures for "total" cotton, i.e., those given in the first column of the table, Fisher's "Z" test showed the experiment to be significant with the following results :—

No differences between Local, S.G.27 and S.G.27.15.13.

Local and S.G.27 both gave significantly higher yields than U.4, S.G.23.8, N.3/5 and S.G.29.

S.G.27.15.13 gave a significantly higher yield than S.G.29 and U.4.

No differences between the others.

The poor showing of N.3/5 and S.G.29 was undoubtedly largely due to the very poor stand given by both these strains. The most outstanding result is the significance of Local and S.G.27 over U.4, which was totally unexpected after the very pronounced superiority of U.4 at Serere in the previous season. The late maturing character of S.G.23.8 was a definite hindrance to it this season when the dry weather caused heavy shedding of the later formed bolls. The flower-curve of this strain indicated at first that it would out-yield all the other strains; but its low boll shedding character was upset by the drought.

The figures in column 3 of Table V represent the percentages of "fifi" cotton. The Analysis of Variance worked out for these figures showed them to be significant with the following results :—

U.4 gave a significantly higher percentage of fifi cotton than any other strain except S.G.27.15.13.

S.G.29 and S.G.27.15.13 gave a significantly higher percentage of fifi than either Local or S.G.23.8.

The proportion of low-grade cotton is very low and this must be ascribed to the absence of stainers throughout the season. The high proportion of low grade cotton in U.4 as compared with the other strains was not unexpected as the number of shrivelled and diseased locks always appeared to be much greater than in the other strains.

Samples of seed cotton from each strain in the trial were examined in the laboratory and the results are summarised in the table below :—

TABLE VI.

Variety.	*Lint Length.*	*Lint Index.*	*Weight 100 Seeds (in gms.)*	*Ginning Outturn.*	*Grader's order of merit.*
S.G.23.8 ...	31·2	5·6	10·8	34·1	6
S.G.27	31·1	5·6	12·5	30·9	1
S.G.29	32·1	5·9	12·4	32·2	2
S.G.27.15.13 ...	33·4	5·7	13·7	29·4	3
U.4	29·7	5·5	10·9	33·5	7
Local ...	32·0	5·2	11·9	30·4	5
N.3/5	31·4	5·4	12·1	30·7	4

U.4 and S.G.23.8 are definitely small-seeded types and for this reason both give high ginning outturns. U.4 produces lint definitely shorter and harsher than our normal cottons and belongs to quite a different class, while S.G.27.15.13 is almost approaching the "too long" type of cotton.

Shedding Experiment.—This experiment was conducted at Bukalasa on lines exactly similar to those followed at Serere in the previous season, collection of shed material being made twice daily. The shed buds and bolls were collected off strips of mosquito gauze wire laid along the two rows under observation. In addition to collection and classification of shed material, flower counts were made daily and bolls picked and counted at five-day intervals. The buds and bolls shed were classified, according to width across the bracts in the case of the buds, and according to the widest diameter in the case of the bolls; classification was also done according to cause of shedding when possible. It was found almost impossible to be certain whether the smaller buds and bolls were shed through physiological or other causes and when any doubt arose they were all put under the heading "physiological". The freedom from insect pests at Bukalasa is clearly shown by the very few buds and bolls classified as showing insect damage; the number of diseased bolls is also practically negligible, but here again it is difficult to ascertain whether small buds and bolls are diseased or not.

This season there was again high correlation between the rainfall peaks and the peaks of bud shedding, which were very high. The boll shedding was mainly due to drought conditions which were experienced from December onwards and which completely curtailed the flowering curves by the middle of January, so that no second crop whatsoever was produced.

The summary of the results obtained is given in the table below :—

TABLE VII.

NUMBER OF BUDS SHED PER PLANT CLASSIFIED ACCORDING TO WIDTH ACROSS THE BRACTS (in mm.)

	2–5 *mm.*	5–8 *mm.*	8–12 *mm.*	12–16 *mm.*	16–24 *mm.*	24 *mm.* & *over*	*Total*
(*a*) *Physiological*—							
Total per plant	85·5	9·9	8·8	7·5	2·9	Nil	114·6
Percentage ...	74·6	8·6	7·7	6·6	2·6	Nil	—
(*b*) *Insect Damage*—							
Total per plant	Nil	Nil	1·2	1·7	1·7	0·1	4·7

NUMBER OF BOLLS SHED PER PLANT CLASSIFIED ACCORDING TO DIAMETER OF BOLL.

	5–8 *mm.*	8–12 *mm.*	12–16 *mm.*	16–24 *mm.*	*Over* 24 *mm.*	*Total.*
Total per plant	24.6	8·6	2·7	0·6	0·06	36·6
Percentage	67·0	23·4	7·6	0·5	0·2	—

TABLE VIII.

SHOWING TOTALS SHED PER PLANT AND TOTALS PRODUCED.

Total Buds shed.	*Total Flowers produced.*	*Total Bolls shed.*	*Total Bolls harvested.*
125	75	42	33

The potential crop was therefore 125 plus 75 i.e., 200 bolls, and the actual crop produced was only 16.4% of the potential, showing a loss through shedding of 83.6% of the possible crop. This is divided into 62.5% due to bud shedding and 21.1% due to boll shedding. Of these totals only 0.54% of the buds shed and 2.4% of the bolls shed could be definitely ascribed to insect pests. The percentage bolls shed to flowers produced was 56.0%. The total loss of 83.6% compares with the 89% observed last season at both Serere and Kampala. These figures are suggestive of the possibility that under conditions in this country not more than 20% of the buds produced will develop into harvestable bolls. It is certain that the cotton plant could not produce a crop from every bud. Isolated plants do undoubtedly produce 200 bolls, but then their budding and flowering is correspondingly higher.

INSECT PESTS AND DISEASES.

Owing to the dry conditions very little damage of any sort was done to the crop by either insects or diseases except for attacks on the young plants by Syagrus.

Syagrus sp.—This pest caused considerable damage to plants in the early stages although the attacks were by no means confined to the young plants. A direct loss of 4% of the plants in the variety trial was ascribed to Syagrus. Quite a number of plants (not included in the estimated loss above) were attacked but recovered later and were able to yield a crop of sorts. The pest only appeared on old plots.

Lygus.—This undoubtedly caused quite a lot of damage on the variety trial, but it is unlikely that it had much effect on the final yield.

Aphis caused some damage to plants in the breeding plot and variety trial, several plants being permanently stunted as a result. Not 1% of the crop was in any way affected by aphis damage.

Jassids.—These were practically not-existent until after most of the crop had been harvested ; they appeared then, but too late to do any damage.

Earias insulana.—This was responsible for very little damage at Bukalasa, few apical buds were damaged, and shed material collected from the shedding experiment showed few cases of spiny bollworm attack.

Dysdercus spp.—Only a single stainer of this genus was observed throughout the season until the plants were uprooted, the result being a very small percentage of stained cotton. The average " fifi " cotton picked from the experimental plots was under 10%, which is equivalent to about 5% commercially, as all experimental cotton is very carefully picked over as soon as it is harvested. This total of 10% compares with a figure of about 25% at Serere from the same experiments, same varieties and same careful picking over.

Diseases.

Angular Leaf Spot.—This disease appeared in August about three weeks after planting and spread rapidly until about 80% of the crop was affected. Very little damage was done except for a few leaves being shed. In very few cases were bolls observed to be infected with the " spot " stage. The amount of blackarm which developed was negligible, only a few isolated plants being attacked.

Ramularia.—Plants in the breeding plot became quite heavily infected with this disease and a considerable number of leaves were shed, one or two strains, U.4.29 in particular, appeared to be more susceptible than others.

Boll Rots.—The absence of stainers meant the comparative absence of boll rots. Very few bolls were observed suffering from these diseases.

Notes on Buganda Province and Eastern Province Crops.

Owing to pressure of work at Bukalasa no tour of the cotton areas of Buganda was possible with the exception of the Bulemezi County, which provided a useful field for selection purposes. The crop in this county was unfortunately planted late and although the flowering rate reached a very high peak and gave promise of a really good crop, the very dry weather experienced in the latter part of the year caused such high boll shedding that a comparatively small crop was reaped. The earlier planted cotton again gave the best yields, some of the late August and early September sown plots hardly producing a crop at all. Angular leaf spot was fairly general, but practically no blackarm was observed. Samples were obtained from Bulemezi and Mawokota Counties and examination of these showed that the staple was considerably shorter than in the last two seasons and that the lint was decidedly rough and weak. There appears to be no lack of evidence that the Buganda crop is undergoing a steady process of deterioration in quality, which is really only to be expected when it is considered that no complete change of seed has been made since the original introduction of Upland cotton. Sunflower was introduced in 1916

but the existing cottons were not entirely destroyed, with the consequence that the present crop consists of an enormous mixture of types.

Samples were received from various ginneries in the Eastern Province as well as from the quarter-acre trial plots, but unfortunately they arrived too late to be dealt with fully in this report. The general crop in this Province showed an immense improvement in quality over that of the previous season, when blackarm was so widespread. The proportion of immature cotton was considerably less this year and the lint index is nearly double and in sone cases considerably higher than normal. The staple of the crop was good as a whole but it shortened off rather towards the end of the season.

SERERE.

Summary of Meteorological Conditions.

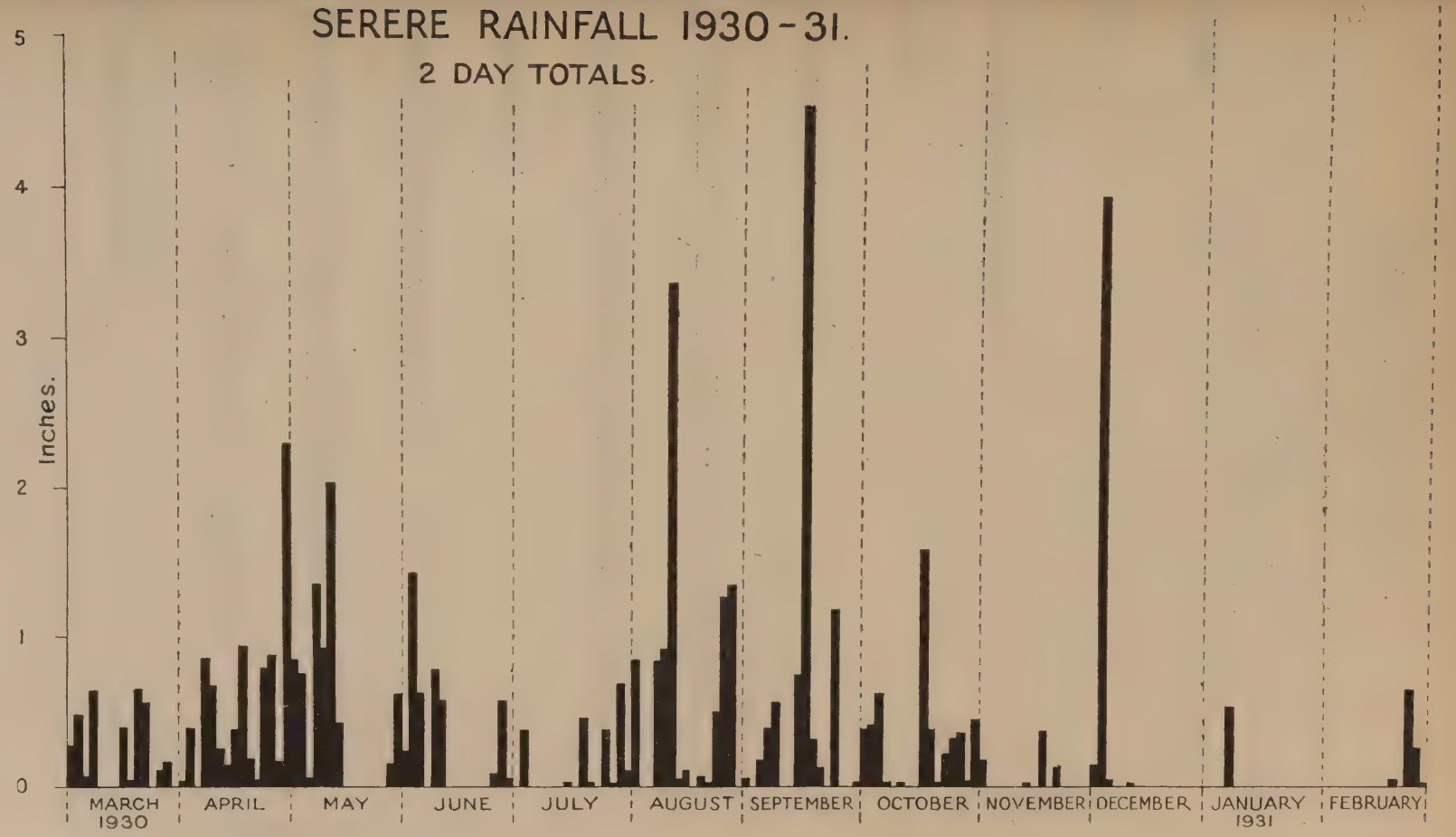
Although the total rainfall for the year was slightly below normal, the two months August and September, were well above the average for these months, and this caused angular leaf spot to spread rapidly. The disease was checked, however, at the end of October. The latter half of the season was drier than usual, and during this dry spell, jassids increased enormously and did considerable damage to certain of the strains.

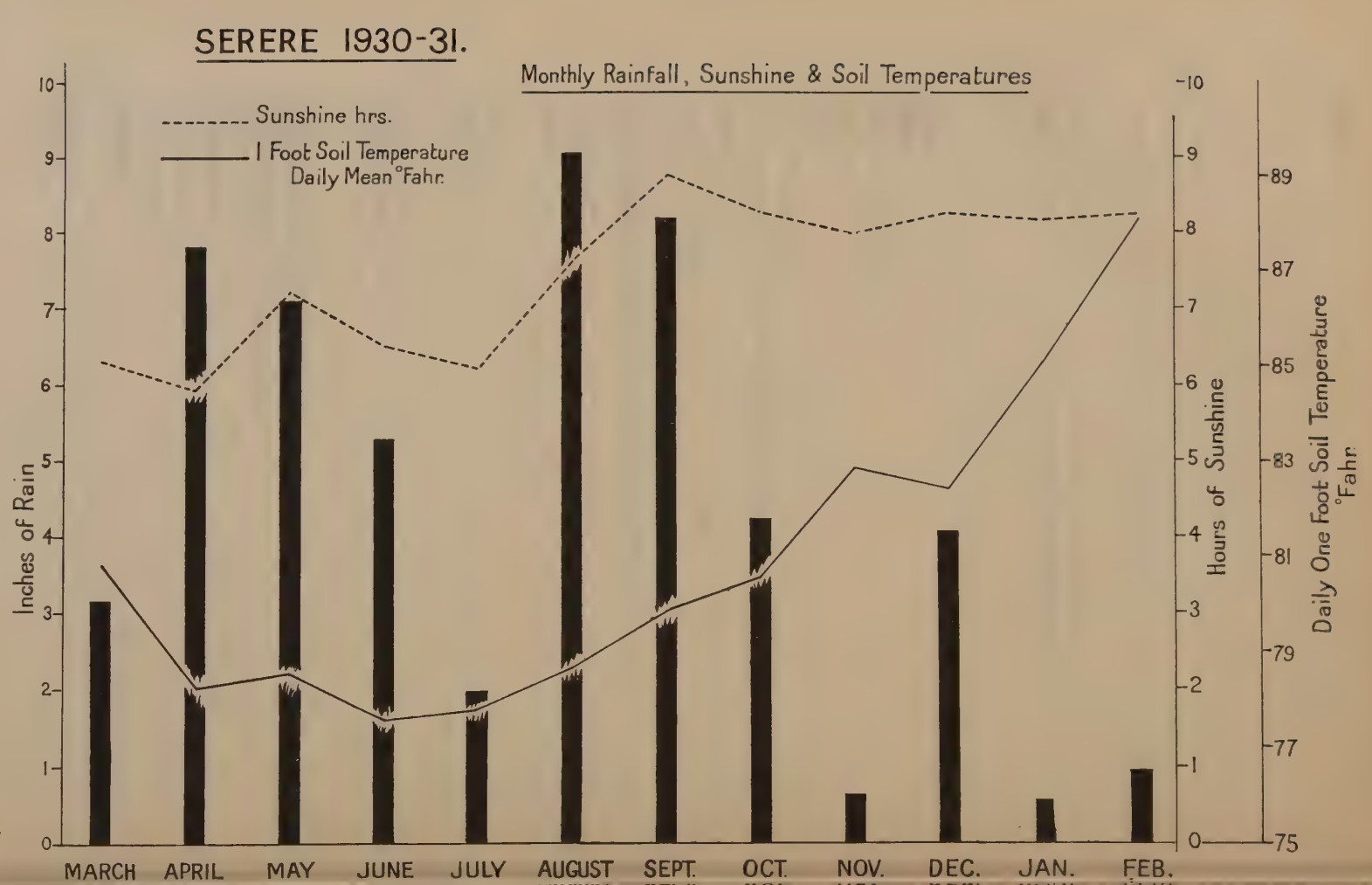
The soil temperatures during July and August—the critical months—were higher than usual.

From the above observations it was to be expected that the blackarm stage of *Bacterium malvacearum* should be far less serious than in the previous season, and this was so.

Breeding Plot.—The first of the three new breeding plots was used this season. The soil appeared to be fairly good and deep and there was little wash. The plot was divided up into three sections—(a) New Selection Series, (b) Pedigree Line Series, and (c) Comparison of U.4 once grown with the original seed.

(a) *New Selection Series.*—Seventy-six strains were grown, the spacing, etc., being similar to that used at Bukalasa. The whole series was planted on July 12th, each hole being hand-watered at the time of sowing. The following groups of families were included—18 selections from U.4, nine from S.G.23.8, six from S.G.85, and five from S.G.29. As at Bakalasa, careful observations were made throughout the season with regard to blackarm disease. The angular leaf spot form appeared


SERERE RAINFALL 1930-31.
2 DAY TOTALS.
Inches.
5
4
3
2
1
0
MARCH 1930
APRIL
MAY
JUNE
JULY
AUGUST
SEPTEMBER
OCTOBER
NOVEMBER
DECEMBER
JANUARY 1931
FEBRUARY


SERERE 1930-31.
Monthly Rainfall, Sunshine & Soil Temperatures
Sunshine hrs.
1 Foot Soil Temperature
Daily Mean °Fahr.
Inches of Rain
Hours of Sunshine
Daily One Foot Soil Temperature °Fahr.
0
1
2
3
4
5
6
7
8
9
10
75
77
79
81
83
85
87
89
MARCH
APRIL
MAY
JUNE
JULY
AUGUST
SEPT.
OCT.
NOV.
DEC.
JAN.
FEB.

early in September and after a check in the middle of the month spread rapidly, until on October 1st at least 95% of the plants in the plot were infected. Considerable variation in the intensity of the attack was observed. S.G.129 (a selection from a native plot near Nariama) was the most resistant line, while U.4.5, S.G.93a (a re-selection from S.G.35) and the S.G.88 families (Acala var.) were comparatively resistant. Practically no blackarm occurred in the plot.

Few strains were outstanding from the yield point of view, the S.G.85 families being very disappointing, as at Bukalasa. The most promising material in the series were selections made in S.G.88, S.G.129, and U.4 families, and also families of S.G.35 which have now reached commercial purity.

The following table gives a summary of the quantitative characters of the most important re-selections made amongst the New Selection Series :—

TABLE IX.

Plant No.	*Seeds per boll.*	*Motes per boll.*	*Lint weight per boll in gms.*	*Lint Index.*	*Lint Length (mm.)*	*Ginning Outturn.*	*Number of bolls produced.*
S.G.129.2	35·0	1·0	2·00	5·7	29·2	34·4	77
S.G.129.4	34·0	1·0	1·94	5·7	30·1	29·3	32
S.G.129.9	36·0	2·5	2·65	7·4	29·3	39·0	36
S.G.88.1.2	39·5	2·0	2·69	6·8	30·7	35·9	—
S.G.88.1.7	42·0	2·0	2·44	5·8	31·0	37·0	31
S.G.88.1.13	32·5	2·5	2·14	6·6	29·0	35·8	38
U.4.1.2	36·0	1·5	2·55	7·1	30·8	38·6	45
U.4.1.12	34·0	0·0	2·10	6·2	31·8	37·4	23
U.4.30.15	34·8	1·5	2·61	7·5	30·8	37·6	25

It is noteworthy that the U.4 families did very much better at Serere than at Bukalasa—at Bukalasa very few plants produced lint with 30mm., whereas at Serere quite a large number reached that length. The drier conditions of the Eastern Province would appear to be more suitable for U.4 than the comparatively moist Lake basin area. The lint weights and lint index figures are high this season, nearly twice those obtained last year. It is remarkable that at Bukalasa, where conditions are more favourable for cotton, a much lower lint index was obtained, but as a general rule (U.4 excepted) the staple is from 1 to 2 mm. longer at Bukalasa than at Serere for the same cottons.

(b) *Pedigree Line Series.*—As at Bukalasa, each line consisted of two rows of 25 plants each with a row of S.G.29 cotton on either side for eye comparisons.

U.4.4.2.—This strain was obtained from Mr. Parnell of Barberton. It showed considerable promise as it was markedly resistant to both angular leaf spot and jassids. The forty-nine plants grown gave a mean lint length of 28.73±0.12 mm. Eleven of these plants were selected for increase in the next season. The mean lint length of these eleven plants was 30.12±0.17 mm. In the first instance the staple is too short, but by selecting inside the strain eleven plants have been obtained whose mean lint length is significantly longer than the remainder. In addition to this, two plants were selected and will be placed in the pedigree lines again in the coming season as two new strains. The mean lint lengths of these two plants were 32.5±0.40 mm. and 30.1±0.37 mm. respectively. The longer is significantly better than any other of the forty-nine in the line.

S.G.35.10.14.1.2.
S.G.35.10.14.8.1. } These two strains were practically identical, except that the first gave green fuzzed seeds while the other had normal white fuzz. Both strains showed resistance to jassid and gave quite good yields, S.G.35.10.14.8.1 was definitely more resistant to angular leaf spot and has been bulked for further increase.

S.G.27.15.13.5.7.—This was quite promising. The size of the individual bolls being particularly large. It was not so resistant to angular leaf spot or to jassid as the above strains, but since the quality of the lint is promising and it is approaching a " pure line " it will be bulked for the next season.

PEDIGREE LINES.

	U.4.4.2 *49 plants.*	U.4.4.2 *11 selected plants.*	S.G.35.10.14.8.1 *49 plants.*	S.G.27.15.13.5.7 *29 plants.*
Seeds per boll	32·4	32·0	30·5	32·5
Motes per boll	1·9	2·4	4·2	3·4
Seed wt. per boll gms.	3·21	3·17	3·37	4·18
Lint wt. per boll gms.	1·96	1·96	1·89	2·20
Lint length mm.	28·7 ± 0·12	30·2 ± 0·17	30·7	30·8
Lint Index	6·04	6·12	6·21	6·77
G.O.T. % calculated	37·9	38·2	35·9	34·5
Total bolls per plant	34·5	44·2	21·0	22·2
Good bolls per plant	8·94	11·55	4·94	6·34

Three families of S.G.37.1.3.14 (originally selected from Allen) were grown. All of these went down very badly to jassids, angular leaf spot and some blackarm. They have all been discarded.

Three families of S.G.23.8.6.13 selected on account of their low shedding habit were so badly attacked by jassids that they produced practically no crop at all. They have also been discarded.

(c) *Comparison of U.4 once grown at Serere with U.4 as originally obtained from Barberton.*—The object of this small experiment was to determine whether acclimatisation had had any effect on U.4 and whether the seed had become infected with blackarm after being subject to the disease in the previous season. Fifteen thirty-plant rows were grown from each seed type, the rows being in random pairs. Germination was higher for the once-grown than for the original seed, the figures being 81% for the original against 90% ; this, however, was to be expected, as the original seed was three years old and was certain to have lost vitality. The percentage attacked by angular leaf spot was 60% in the original and 76% in the once grown. This was not a significant difference but did give some indication of increase in infection or susceptibility through being grown at Serere. These figures were taken in September and by the end of October the differences had evened up. Each row was harvested separately and the final yields were as follows :—

Variety.	*Mean Yield per Row (lbs.)*	*S.E. Difference.*
U.4 (Original)	2.81	—
U.4 (Once grown)	3·22	0·15

The results satisfied Fisher's " Z " test and thus U.4 once grown shows a significant increase in yield over the original. This increase may have been in part due to better germination, but it definitely shows that no deterioration with regard to yield has occurred by growing U.4 once at Serere.

Increase Plots.

(a) *Small Bulk.*—Three such plots were grown at Serere : S.G. 27.15.13, S.G.96 and N.3/5 from Bukalasa. S.G.27.15.13 yielded at the rate of over 1,200 lbs. per acre after a poor stand and some blackarm. The plot of N.3/5 was planted in connection with the interchange of

seed experiment—it yielded at the same rate as S.G.27.15.13. The strain S.G.96 produced evidence of vitiation and has as a consequence been scrapped.

(b) *Medium Bulk.*—A two-acre plot was planted with U.4 for seed supply purposes and yielded at the rate of 930 lbs. per acre. The germination of the first planting (in July) was only 30% but after re-sowing a good stand was obtained. Owing to the comparatively poor quality of this variety and to the fact that it showed no signs of last season's superiority in yield over our existing strains it is not intended to proceed any further with multiplication of it, but it is hoped that by selection a strain with an improved quality may be obtained.

(c) *Bulk Increase.*—The 30 acres on the main farm at Serere were planted with S.G.23.8, this strain having shown promise in yield trials in the previous year and having obtained such excellent reports on its lint. Although this strain was badly attacked by jassid in all the variety trials, including the one at Serere, yet on the main farm practically no damage was observed and a yield at the rate of 550 lbs. per acre was obtained. This jassid susceptibility has made it unwise to proceed further with the multiplication of this strain.

(d) *Mulondo Segregated Area.*—(Now in its second year of operation.) This was planted with S.G.29, the seed being taken from the previous year's crop in that area. The area planted was just over 402 acres as compared with about 300 acres in the previous season. This was a very satisfactory increase.

The early sown cotton yielded at over 1,000 lbs. to the acre, but owing to very dry local conditions later in the season the later sowings did not come up to expectations. The total buyings from the area were 246,213 lbs. of seed cotton; this shows an average yield of 612 lbs. per acre.

The crop was bought and ginned by Messrs. Foster Bros. Fifty bales were sent home and were sold by the British Cotton Growing Association. Ten bales were sold on August 7th at 149 points on, and 40 bales on August 10th at 155 points on, the average price being 5.16d. per lb.

The brokers' valuation was 150 points on with July American futures at 4.80d. per lb.

Classification. High colour, rather dull, some leaf and stain.

Staple $1\frac{3}{16}$ inches to $1\frac{1}{4}$ inches Silky. Fairly strong.

(e) *Limited Distribution.*—(Stage 7.) In the previous season the yield from the Mulondo area was greatly reduced by blackarm, consequently it was not possible to plant as much as 7,000 acres in

the next stage during the season under review. 2,540 acres were planted with S.G.29 in the Kadunguru gombolola. The natives in this area were supplied with marked bags. These bags were kept separate at the buying posts of Messrs. Foster Bros. and of The East African Ginneries, who normally buy the crop from this district. The total buyings were 1,059,385 lbs. of seed cotton, giving an average yield of 417 lbs. per acre ; which would have been considerably higher but for the dry spell experienced during the growing period. Since this yield was above expectation, the first unit of 50,000 acres will be planted in the coming season. Thus, although only 2,500 acres were planted instead of 7,000, no time has been lost, which is very satisfactory since it shows that the estimated multiplication ratios between the successive stages are well on the safe side.

S.G.29 was not included in the one-quarter acre trial plots this season, being replaced by S.G.23.8, but comparisons with N.17 (Local) are possible at the nine variety trial centres ; at six out of the nine S.G.29 gives a higher yield than N.17, at one there is practically no difference, and at two N.17 gives a higher yield than S.G.29. In general quality and uniformity S.G.29 is a distinct improvement on N.17 at all centres.

Brokers' and spinners' reports were received on samples from some of the one-quarter acre trial plots of N.17 and S.G.29 of the previous season. It was hoped that the results of these tests would make it possible to form rough quality maps of the Eastern Province which would be valuable in the estimation of the locality effects on variety. Unfortunately, too few samples could be reported on—only 25 pairs for brokers' reports and nine pairs for spinning tests—to make any true differentiation into quality areas possible. In addition, the " quality " according to the brokers was in several cases at variance with the spinning test results. The general results showed a balance in value of crop per acre in favour of S.G.29 for all districts except Bugwere. The spinning report stated that the locality effect was more pronounced than the variety effect except at Buluya, where S.G.29 is definitely superior to N.17, and at Ngetta, where the reverse is the case. The samples from Gogonyo and Awelo gave best results, while those from Buyende were definitely the worst. It will be noticed in the table below that the broker valued N.17 at Buyende considerably higher than any other of the samples under consideration, whereas it produced the weakest yarn. The staple appears to bear little relation to the strength and appearance of the yarn as the Gogonyo samples which produced the shortest staple were cited as producing the best yarns.

TABLE X.

SUMMARISING BROKER'S AND SPINNING REPORTS ON SAMPLES FROM THE ONE-QUARTER ACRE TRIAL PLOTS OF S.G.29 and N.17, 1929-30 SEASON.

Centre.	*Lea Strength.*		*Strength × Count*		*Broker's Valuation in pence per lb.*		*Broker's Staple.*		*Staple by pulled tuft.*		*Yield in lbs. per quarter-acre.*	
	N.17	*S.G.29*	*N.17*	*S.G.29*	*N.17*	*S.G.29*	*N.17*	*S.G.29*	*N.17*	*S.G.29*	*N.17*	*S.G.29*
									mm.	*mm.*		
Busoga—												
Buluya	52·6	56·6	2,078	2,298	7·85	7·40	1 3/16	Full 1⅛	31·1	30·1	236	354
Vukula	53·9	52·6	2,210	2.157	7·85	7·30	1⅛–1 3/16	Full 1⅛	30·4	32·4	132	122
Buyende	49·0	49·1	1,960	1,944	8·60	7·40	1 3/16	Full 1⅛	31·0	31·6	109	93
Bugwere—												
Gogonyo	54·2	56·1	2,195	2,250	7·45	7·10	Full 1⅛	Full 1⅛	29·0	28·0	105	74
Budama—												
Musafu	52·5	54·9	2,132	2,158	7·35	7·45	Full 1⅛	1⅛–1 3/16	28·1	29·5	34	39
Lango—												
Awelo	57·5	56·4	2,288	2,262	7·10	7·30	1⅛	1⅛–1 3/16	29·8	30·1	97	151
Ngetta	56·3	52·0	2,224	2,038	6·85	7·10	1⅛	1⅛–1 3/16	29·4	30·1	46	45
Teso—												
Serere	53·6	53·8	2,219	2,125	7·60	7·30	1⅛	1⅛	29·5	30·8	71	66
Labori	56·3	56·8	2,241	2,232	7·10	7·85	1⅛	1⅛–1 3/16	30·4	31·2	83	71

The above samples were spun to 40's (Twist Ring).

Variety Trial.

The plot chosen for the Variety Trial at Serere was the most even piece of land in the newly opened block, the position, size, shape and number of plots being determined from the results obtained from the Uniformity Trial of the previous year.

The land was planted with Bulo (*Eleusine*) which was ploughed in some time prior to planting. The lay-out adopted was in the form of random blocks, there being 12 blocks of eight plots each. Each plot was 27 feet by 27 feet (approx. $\frac{1}{60}$th acre) with a spacing of 3 feet by 1 foot and six seeds sown per hole.

The following varieties were under test—N.17 (Local), N.17 (Busoga); (these two were included in this and three outside trials in order to find out if the introduction of seed from the blackarm-free areas in Busoga had any effect on the yield of the crop,) S.G.27, S.G.29, S.G.23.8, S.G.27.15.13, S.G.96 and U.4. These are all derivatives from Nyasaland Upland type, except U.4, which may have been derived from Sunflower.

The plots were planted on July 25th, later than usual owing to a prolonged dry spell in the middle of July. Germination was rapid and the original stand gave a mean of 81% which was raised to 90% after the first re-sowing. There were considerable differences in the germination capacity of the several varieties which were shown as being significant by Fisher's Analysis of Variance. The results are tabulated below :—

Percentage Stand.

Varieties.

N.17 (Local)	*N.17 (Busoga)*	*S.G.23.8*	*S.G.27*	*S.G.29*	*S.G.27.15.13*	*U.4*	*S.G.96*
65	72	92	91	85	75	93	77

The S.E. of Comparison = 2.6

The results were :—

No difference between S.G.27, S.G.23.8 and U.4.

S.G.27, S.G.23.8 and U.4 gave significantly better stands than S.G.29, S.G.96, S.G.27.15.13 and N.17 varieties.

S.G.29 significantly better than S.G.27.15.13 and both N.17s.

S.G.96 significantly better than both N.17s.

S.G.27.15.13 significantly better than N.17 (Local)

Indications that N.17 (Busoga) is better than N.17 (Local).

Angular leaf spot appeared early in October and 90% infection occurred in a few days. There was, however, practically no sign of blackarm at any time and the plants recovered from the leaf spot attacks. Picking commenced on December 1st and continued at weekly intervals until February 16th.

The most noteworthy feature of this trial was the breaking down of the hitherto promising strain S.G.23.8 under jassid attacks. In January the plots of this strain could be picked out from a considerable distance owing to the reddening of the leaves and stunting of the plants. No other strain appeared to suffer much damage from this pest and it is very useful to have evidence of the jassid susceptibility of S.G.23.8 before further increase has taken place.

In picking, first and second quality cottons were carefully separated and the results have been worked out (a) on total yields, and (b) on percentage of stained and low quality cotton.

The results from the " Total seed cotton " are as follows :—

TABLE XI.

MEAN YIELD PER PLOT IN LBS.

Varieties.

S.G.27	*U.4*	*S.G.96*	*S.G.27. 15.13*	*S.G.29*	*N.17 (Busoga)*	*N.17 (Local)*	*S.G.23·8*	*M.*	*SE.Diff.*
11·9	11·8	11·7	11·4	11·3	10·6	9·7	8·6	10·9	0·62

YIELDS AS PERCENTAGE OF THE MEAN.

Varieties.

S.G.27	*U.4*	*S.G.96*	*S.G.27. 15.13*	*S.G.29*	*N.17 (Busoga)*	*N.17 (Local)*	*S.G.23.8*	*M.*	*S.E.Diff.*
109	108	107	104	104	97	89	79	100	5·7

There was no significant difference between S.G.27, U.4, S.G.96, S.G.27.15.13, and S.G.29.

U.4, S.G.27 and S.G.96 gave significantly higher yields than both types of N.17 and S.G.23.8. S.G.29 and S.G.27.15.13 gave significant yields over Local N.17.

All strains were significant over S.G.23.8.

These results, when compared with those of the Serere Variety Trial last year, are remarkable. U.4 instead of giving twice the yield of any other variety is bracketed with four others. It does not appear that U.4 is resistant to blackarm as it was badly affected with angular leaf spot this season, but its superiority last season was probably due to its comparative freedom from seed infection. This year the balance had evened up and conditions were against the development of the disease. Again, last year the strain S.G.23.8 came next to U.4 in order of yield, while this year it is a bad last owing to jassid which was not present in large quantities last year.

The results worked out on percentage of " fifi " are given below ; the percentage is higher all the way through than it would be commercially as all pickings were very carefully picked over.

TABLE XII.

PERCENTAGE FIFI.

Varieties.

U.4	*S.G.28*	*S.G.23.8*	*N.17 (Busoga)*	*N.17 (Local)*	*S.G.29*	*S.G.27*	*S.G.27.15.13*	*M.*	*S.E.Diff.*
30·6	28·3	27·4	27·3	27·2	26·0	25·0	24·8	26·9	1·67

U.4 gave a significantly higher percentage of "fifi" cotton than S.G.27, S.G.29, S.G.27.15.13, and both types of N.17.

S.G.96 gave a higher percentage than S.G.27 and S.G.27.15.13.

These results are interesting to compare with those from Bukalasa :— U.4 gives a higher percentage of low-grade cotton at both places, but the order of the other varieties is different and S.G.27.15.13 gives proportionately a higher percentage of fifi at Bukalasa than at Serere, while with S.G.23.8 the case is reversed.

The examination of seed cotton samples from these varieties gave the following figures :—

TABLE XIII.

Variety.	*Lint Length. mm.*	*Lint Index.*	*Seed Weight Gms. per 100 seeds.*	*Ginning Outturn.*
S.G.27	30·3	6·13	13·4	31·4
U.4	28·1	6·40	10·1	38·7
S.G.27.15.13 ...	30·5	7·54	14·6	34·1
S.G.29	31·3	6·28	14·3	30·5
N.17 (Busoga) ...	28·9	6·20	12·5	33·1
N.17 (Local) ...	30·2	6·44	12·7	33·8
S.G.23.8	29·7	6·00	11·1	35·1

The noteworthy feature of the above table is the very high lint index, especially when compared with that of last year, which was very little more than half the above figures. Both lint indices and seed weights are higher than those given at Bukalasa in practically every strain, while the lint lengths are shorter in every case.

OUTSIDE VARIETY TRIALS.

Variety trials were conducted at the following centres in the Eastern Province, each centre being selected as being representative of definite soil and climatic area.

Labori ...	...	Teso District
Orungu ...	...	,, ,,
Ngora	...	,, ,,
Kamuge ...	...	Bugwere ,,
Vukula ...	...	Busoga ,,
Ngetta... ...	...	Lango ,,
Aduku ...	...	,, ,,
Kaberamaido	...	,, ,,

The following varieties were grown at each centre :—S.G.27, S.G.29, S.G.23.8, U.4 and N.17 (Local), while at Labori, Ngetta, and Ngora, N.17 (Busoga) was also included. The size of plot was 1/40th acre at every centre.

A trained native observer was stationed at all centres and he was responsible for rainfall records, flower counts and general supervision of the plots.

Labori.—The site of the experiment was on the same plot as the previous season. A crop of *Eleusine* was sown after last season's crop was taken off and this was ploughed in as a green manure on May 21st. General observations made in this fruitful area showed that in most years early planting was advisable and this experiment was accordingly planted on June 5th. Much of the *Eleusine* was unrotted and had to be carried off before planting was possible. Spacing was 3 feet by 1 foot with six seeds per hole. Excellent conditions followed planting and a good stand was obtained. The resultant crop yielded at the amazing rate of over 2,000 lbs. per acre, which demonstrates the capabilities of our cottons, given optimum conditions.

The very excellent conditions completely masked the slight differences in yield which have been given at other centres by several of the varieties under test.

The following table gives the yields per plot :—

TABLE XIV.

MEAN YIELD PER 1/40TH-ACRE PLOT IN LBS.

Varieties.

*S.G.*27	*S.G.*29	*S.G.*23.8	*U.*4	*N.*17 (*Local*)	*N.*17 (*Busoga*)	*Mean*
55·5	54·0	53·0	54·0	55·5	54·9	54·4

Ngora.—The lay-out here was in the form of six random blocks—Nos. 1, 2 and 3 being situated on a plot which had been under cotton the previous season, while the other three blocks formed an extension of this plot which had not been under cultivation for some time. Planting was done on June 19th with the same spacing and seed rate as at Labori. The crop as a whole did well, but S.G.23.8 suffered badly from jassid and is again last in order of yield. The results from this trial showed no significance by Fisher's " Z " test but the mean yields are given for interest as they follow closely the order given at Serere.

TABLE XV.

YIELDS IN LBS. PER 1/40TH ACRE.

Varieties.

*U.*4	*S.G.*27	*N.*17 (*Busoga*)	*S.G.*29	*N.*17 (*Local*)	*S.G.*23.8	*Mean.*
19·0	18·0	15·4	15·3	15·0	14·8	16·3

The variation between blocks was rather high, the extreme means being 12·2 and 21·5. The highest yielding blocks were those which had not been under recent cultivation.

Orungu.—The lay-out here was also six random blocks, but the site was rather poor and again no significant differences were obtained. The mean yields per plot were :—

TABLE XVI.

YIELDS IN LBS. PER 1/40TH ACRE PLOT.

Varieties.

U.4	*S.G.27*	*S.G.29*	*N.17*	*S.G.23.8*	*Mean*
14·8	13·8	12·7	12·3	11·8	13·1

The low position of S.G.23.8 is again evident, while S.G.27 maintains a higher position than S.G.29.

Kamuge.—The variety trial was sited on the small lukiko farm. The soil is a reddish loam and the conditions are generally typical of Pallisa County, but the soil is not as fertile as the rest of Bugwere. The lay-out adopted was a Latin square five by five, the plots being the same size as in the other experiments. Spacing and seed rate were also the same. The trial was sown on July 5th when conditions were at their best. The yields were low compared with those obtained at other centres; there was no outstanding feature amongst the varieties during the season, except that S.G.23.8 was not badly attacked by jassid at this centre.

The results were as follows :—

TABLE XVII.

YIELDS IN LBS. PER 1/40TH-ACRE PLOT.

Varieties.

U.4	*N.17 (Local)*	*S.G.27*	*S.G.23.8*	*S.G.29*	*M.*	*S.E.Diff.*
10·8	9·9	9·6	9·1	8·5	9·6	0·63

YIELDS AS A PERCENTAGE OF THE MEAN.

Varieties.

U.4	*N.17 (Local)*	*S.G.27*	*S.G.23.8*	*S.G.29*	*M.*	*S.E.Diff.*
113	103	100	95	89	100	6·56

The experiment showed significance by the " Z " test and gave the following results :

U.4 significantly higher yield than all varieties except local.

Local significantly higher than S.G.29.

The results comparing N.17 with S.G.29 at this centre indicate that the former is more suited as regards yield to this area as in two consecutive seasons, very different climatically, N.17 has given a significant increase in yield over S.G.29.

Kaberamaido.—The lay-out here was in the form of a five by five Latin square, the plot size, etc., being standard. A good stand was obtained but heavy rain late in the season caused a great amount of boll shedding. The results are tabulated below and once again these do not satisfy Fisher's " Z " test. The positions of the varieties in order of yield are similar to those in the Teso trials, S.G.23.8 being last again.

TABLE XVIII.

YIELD IN LBS. PER 1/40TH-ACRE PLOT.

Varieties.

S.G.27	*U.4*	*S.G.29*	*N.17 (Local)*	*S.G.23.8*	*Mean.*
21·8	21·6	21·4	18·4	16·0	19·8

Ngetta.—This trial was similar to that at Kaberamaido except that it was a six by six Latin square owing to the addition of N.17 (Busoga). Again no significant results were obtained, but the order of yield was similar to that at Kaberamaido.

TABLE XIX.

YIELD IN LBS. PER 1/40TH-ACRE PLOT.

Varieties.

S.G.27	*U.4*	*S.G.29*	*N.17 (Busoga)*	*S.G.23.8*	*N.17 (Local)*	*Mean*
14·0	13·0	12·9	12·3	12·1	11·7	12·7

Aduku.—A Latin square was impossible here owing to the very poor block available for the experiment and the lay-out was in the form of five random blocks. This trial was unexpectedly the only outside trial, except for Kamuge, which gave significant results. It is interesting to note that whereas S.G.27 is either top or next to top as regards yield in all the other trials, here it is at the bottom of the list with S.G.23.8 as usual near the bottom. The yields were as follows :—

TABLE XX.

YIELDS IN LBS. PER 1/40TH-ACRE PLOT.

Varieties.

S.G. 29	*U.4*	*N.17 (Local)*	*S.G.23.8*	*S.G.27*	*Mean.*	*S.E.Diff.*
17·5	17·2	15·8	13·9	12·8	15·4	1·20

YIELDS AS PERCENTAGE OF THE MEAN.

S.G.29	*U.4*	*N.17 (Local)*	*S.G.23.8*	*S.G.27*	*Mean.*	*S.E.Diff.*
114	112	103	91	83	100	7·8

Results.—S.G.29 and U.4 significantly higher yields than S.G.23.8 and S.G.27, while there are indications that the increase of S.G.29 over Local is significant.

Local significantly higher yield than S.G.27.

Vukula.—The site chosen was on rather light sandy soil on the same plot as the quarter-acre trial plots in the previous season. The lay-out was in the form of random blocks and the results were not significant.

The yields were as follows :—

TABLE XXI.

YIELDS IN LBS. PER 1/40TH-ACRE PLOT.

Varieties.

S.G.29	*U.4*	*S.G.23.8*	*S.G.27*	*N.17 (Local).*
25·5	24·5	24·4	23·9	22·7

The general results of all these trials confirm the results obtained at Serere, namely, that U.4 is not superior in yield and is definitely inferior in quality to S.G.27, S.G.29 and Local. S.G.23.8 has been attacked by jassids at nearly every centre and this alone makes it unwise to proceed further with this strain despite its excellent spinning qualities. S.G.29, which is being distributed to replace N.17, is generally giving higher yields than N.17 ; only in two centres did N.17 give a higher yield than S.G.29.

SUMMARY OF THE EASTERN PROVINCE VARIETY TRIALS.

THE MEAN YIELD OF EACH VARIETY EXPRESSED AS PERCENTAGE OF THE GENERAL MEAN FOR EACH CENTRE.

Variety.	TESO.				BUGWERE.	BUSOGA.	LANGO.			*Mean.*
	Serere.	*Labori.*	*Orungo.*	*Ngora.*	*Kamuge.*	*Vukula.*	*Ngetta.*	*Aduku.*	*Kabera-mairdo.*	
N.17 Local	89	102	94	92	103	—	92	103	93	96
N.17 Busoga	97	101	—	95	—	94	97	—	—	97
S.G.23.8	79	95	90	91	95	101	95	91	81	91
S.G.27	109	102	105	110	100	99	110	83	110	103
S.G.29	104	99	97	94	89	105	101	114	108	101
U.4	108	101	113	117	113	101	102	112	109	108
S.G.27.15.13	104	—	—	—	—	—	—	—	—	—
S.G.96	107	—	—	—	—	—	—	—	—	—

EXAMINATION OF SAMPLES FROM THE VARIETY TRIALS.

Samples of seed cotton were examined from all the Variety Trials with the exception of Vukula and Aduku. The full results from these entail too many tables for inclusion in this report, but a few of the more outstanding points are discussed here.

The most striking point is the increase in the value for lint index as compared with that of last year when the influence of blackarm caused so marked a reduction in this character. Lint index values of over 6·00 were by no means uncommon. It is noteworthy that most varieties gave their highest lint index at Kamuge—the lowest yielding centre—while the figures from Labori with a yield of 2,000 lbs. were comparatively low, the figures being 6·42 for Kamuge and 5·65 for Labori.

With regard to staple, not much variation due to place effect is observed ; Kamuge appears to have a depressing action on length, except in the case of N.17 which appears to be particularly suited to this centre, while Labori and Orungu produced lengths above the mean. It is noteworthy that U.4 is definitely at least 2 mm. shorter than any other of the varieties at all centres, while S.G.27 and S.G.29 are both 1 mm. longer than N.17. The general average length of all samples is just 30 mm.

With regard to ginning outturn and seed weight, which are closely correlated, considerable place effect is noticeable ; for instance, Kamuge and Ngora, giving the lowest seed weights, give the highest ginning outturns. It is also remarkable that there appears to be a distinct relation in this season's results between high ginning outturn and lower yields—this is clearly shown in the following table—the Ngora results being the only exception to the general tendency.

Centre.	*Ginning Outturn.*	*Yield per 1/40th-acre. lbs.*
Kamuge	37·5	9·6
Ngetta...	34·3	12·7
Ngora	34·3	16·3
Orungu	34·1	13·1
Serere	33·8	16·3
Bukalasa	32·4	16·2
Labori	31·7	54·4

Quarter-Acre Trial Plots, Eastern Province.

The results obtained from the quarter-acre trial plots of S.G.29 and N.17 last year showed that this method of comparison as an adjunct to the ordinary Variety Trials is likely to be very useful in deciding whether a new strain is worthy of distribution, and in addition, when they have been carried on for several seasons, they will give valuable information as to the various yield and quality areas which exist in the Eastern Province. This season they were repeated at the same centres, but S.G.23.8 replaced S.G.29 as it appeared to be a better quality cotton than S.G.29. Unfortunately, as has been already mentioned, the strain went down very badly to jassids and has as a consequence been withdrawn. The results taken as a whole show no differences between the two strains, but taken district by district it is seen that S.G.23.8 gives a higher yield than N.17 in Busoga, especially in the elephant grass area (there were very few jassids in this part of the country last season), while in Bugwere, Budama, Bugishu and Lango N.17 yields better than S.G.23.8. The Bugwere results were undoubtedly affected by two centres where N.17 gave a higher yield than S.G.23.8, the difference between the two varieties being much greater than could be due to varietal difference, and this must have been due to very unlike plots. The Lango results must have been partially due to jassids. There is no practical difference between the two strains in Teso. The results are summarised in the table below ; unfortunately it has been impossible to deal with all the samples from these plots so that the results of the examination of these cannot be included in this report.

It is interesting to compare the mean yields from these plots in the various districts with those obtained from similar centres in the previous season. In some cases more than double the yield has been obtained. That the Teso plots have yielded more than the Busoga plots is unusual, but they have been influenced by the yields at Labori out of all proportion to the extent of that high yielding area, the mean yield, excluding Labori, being 133 lbs. per quarter acre instead of 186.

TABLE XXII.

SUMMARY OF RESULTS OF ¼-ACRE TRIALS.

District.	*Number of Comparisons.*	*Mean Yield per ¼-acre.*		
		*S.G.*23·8	*N.*17	*N.*17 (1929-30)
		lbs.	*lbs.*	*lbs.*
Busoga	9	206	184	148
Bugwere	9	126	152	55
Budama	4	85	114	78
Bugishu	4	159	167	85
Teso	8	181	186	46
Lango	9	158	177	64
Mean ...	43	153	163	79

CHANGE OF SEED.

Owing to the severe attack of blackarm which occurred in Teso and Lango districts last season, a change of seed was considered advisable, and accordingly N.17 seed from areas comparatively free from blackarm in Busoga was planted throughout Teso and Lango. In order to find out what was the effect of this change of seed, Local N.17 and the Busoga N.17 were included in four of the variety trials, three in Teso and one in Lango. The germination was in favour of Busoga seed at all centres, being about 8% better than Local seed. There appeared to be no difference between the two with regard to infection by angular leaf spot. The final yields showed no differences whatsoever; as is seen in the table below there was a difference of 0·4 lbs. per 1/40th-acre plot between the means in favour of Busoga seed; this is not significant, and in production of lint the Local seed produced 0·3 lbs. per 1/40th-acre more than Busoga seed owing to a higher ginning outturn. Samples of seed cotton were examined from the four centres; these showed no real difference in mean staple length, Local being slightly longer on the average, but in every case the cotton from Busoga seed was very definitely more irregular than that from Local seed. Lint index gives no real differences, but the ginning outturn is higher in the case of Local seed. The general conclusions from the above experiments may be summarised by stating that the introduction of Busoga seed gave a better stand (in the neighbourhood of an 8% increase) than Local, but there was no difference in the final yields. The lint from Local seed was more regular than that from the Busoga seed and was slightly longer.

TABLE XXIII.

SUMMARISING RESULTS OF A COMPARISON OF N.17 FROM BUSOGA WITH LOCAL N.17.

Centre.	*Yield in lbs. per 1/40th acre.*		*Lint Length (in mm.)*		*Lint Index.*		*Ginning Outturn.*	
	Local.	*Busoga.*	*Local.*	*Busoga.*	*Local.*	*Busoga.*	*Local.*	*Busoga.*
Labori	55·5	54·9	30·3	30·7	5·48	5·67	31·1	31·7
Serere	14·5	15·8	30·2	28·9	6·44	6·20	33·8	33·1
Ngora	15·0	15·4	29·6	29·4	5·12	5·03	34·3	30·9
Ngettz	11·7	12·3	30·7	29·5	6·80	6·37	35·2	32·0
Mean	24·2	24·6	30·2	29·6	5·96	5·82	33·6	31·9

Brokers' valuations of samples from Serere and Ngetta reverse local opinion, as in both cases Busoga seed was valued at a higher rate than Local.

Although no differences were observed, except in germination, it is necessary to point out that blackarm was not a serious factor in the season under review—had it been, the results might have been different.

SPINNING TESTS AND BROKERS' REPORTS.

The Empire Cotton Growing Corporation again very kindly made the arrangements for the brokers' and spinning tests, and our thanks are due to them, to Messrs. Wolstenholme and Holland, who graded the samples, and to the Shirley Institute and those who carried out the spinning tests.

The samples referred to below are from the 1929/30 season.

All the samples submitted were ginned on a full-sized Middleton roller gin, the lint being picked over after ginning. When possible the samples were drawn from mid-season pickings.

The results from samples from Serere and Labori Variety Trials are summarised in the table below :—

TABLE XXIV.

NOMINAL COUNT AND TYPE OF YARN—40's RING TWIST. TWIST CONSTANT—3·75.

Variety.	*Lea Strength.*		*Strength × Count*		*Brokers' Valuation on American Middling 5·85d.*	
	Serere.	*Labori.*	*Serere.*	*Labori.*	*Serere.*	*Labori.*
S.G.27 ...	53·3	55·2	2,143	2,241	7·35	7·20
S.G.27.15.13	54·6	—	2,195	—	7·50	—
S.G.29 ...	53·8	56·8	2,125	2,232	7·30	7·85
S.G.23.8 ...	67·3	64·5	2,699	2,612	7·40	7·10
Local (N. 17)	53·6	56·3	2,219	2,241	7·60	7·10
U.4	53·2	—	2,069	—	6·70	—
U.4 (saw ginned)	51·9	—	2,086	—	6·90	—
Mean (excluding S.G.27.15.13 and U.4)	57·0	58·2	2,296	2,331	7·41	7·31

The most interesting feature of these reports is that while the broker quite definitely preferred the Serere-grown samples to the Labori grown (except in the case of S.G.29), in the spinning tests the Labori-grown cottons produced a better and stronger yarn than did those grown at Serere, except in the case of S.G.23.8. The latter result is to be expected as the Labori conditions are very much more favourable to optimum growth and development than are those which obtain at Serere. The strain S.G.23.8 stands out very definitely as producing the best yarn and it is unfortunate that this strain is so susceptible to jassid.

The comparison of U.4 roller- and saw-ginned shows the saw-ginned to be worth 20 points on the roller-ginned, while from the spinning reports the differences are too slight to be significant.

Broker's Reports on the 1930–31 Samples.

Table XXV below summarises these reports and shows up clearly the differences in value between Bukalasa and Serere, and Serere and Ngetta. The Bukalasa samples are valued at an average of 31 points above those from Serere (comparing similar varieties) and this is probably mostly due to staple difference which was given as approximately 1/8th inch longer for Bukalasa samples. The difference in staple confirms the results of combing and also the opinions of local lint buyers.

The Ngetta samples are again valued lower than those from Serere, except in the case of U.4. The question of difference in staple does not arise here as samples from both centres were classified as having the same staple. This year's samples from Ngetta were definitely softer and more wasty than those from Serere or Bukalasa. This difference between Ngetta and Serere occurs every year and it is hoped to investigate its cause during the coming season.

TABLE XXV.

Broker's valuations of lint in pence per lb.

Variety.	*Bukalasa.*	*Serere.*	*Ngetta.*
S.G.27	5·25	5·05	—
S.G.27.15.13	5·65	5·05	—
Local	5·05	4·90	4·75
Busoga N.17	—	5·40	5·05
S.G.29	5·15	5·00	4·85
N.3/5	5·15	5·05	—
S.G.23.8	5·05	4·55	—
U.4	4·85	4·55	4·55

Based on American Middling 3·80 pence.

Continuous Planting Experiment.

This experiment was repeated on a smaller scale than in previous years, only two plots (in pairs) of each treatment being retained. The results showed that the application of 1,800 lbs. of kraal manure per 1/20th acre has kept the fertility as regards cotton yields up to that of the rest of the Plantation which is under a definite rotation.

TABLE XXVI.

	Manured.	*Unmanured.*
Yield in lbs. per 1/20th-acre plot	28·0	20·0
Lint length in mm.	29·5	30·2
Lint index	4·67	5·04
Weight 100 seeds in gms.	9·25	9·42
G.O.T.	33·5	34·8

These plots have now had cotton for six seasons out of seven, and this season is the fifth in succession under cotton only. Even now a comparatively good yield is being given by the untreated plots, although these plots are subject to considerable wash. There is no real difference between the quantitative characters of the seed cotton, although the figures are slightly in favour of the untreated plots.

This experiment has now been discontinued as any further results will be of academic rather than economic value. The results obtained up to the present time have shown us what they were intended to test, namely, that the application of kraal manure has a definite beneficial effect on the yield and also that cotton can be grown continuously on the same plot for some considerable period without seriously affecting the yield.

Eastern Province Seed Multiplication Scheme.

A glance at the appended table will show the various stages of seed multiplication. It can be seen that it will take 15 years from the pedigree line stage, for a strain to come into general cultivation throughout the Eastern Province.

In the season under review, the strain S.G.29 has reached stage 7. It will thus be another eight years before it is in general cultivation in the whole Eastern Province.

The Eastern Province is divided into eight units of approximately equal area; each unit obtains its seed in turn from the 7,000 acre stage. The units are roughly 50,000 acres each.

MULTIPLICATION SCHEME. EASTERN PROVINCE.

Year.	*Pedigree. Line.*	*¼ acre & Serere Var. Trial.*	*½-acre & Eastern Province Var. Trials.*	*2 acres & 50 ¼-acre compari-sons.*	*30 acres & 50 ¼-acre compari-sons.*	*Mul-ondo.*	*7,000 Acres.*	*1st Unit.*	*2nd Unit.*	*3rd Unit.*	*4th Unit.*	*5th Unit.*	*6th Unit.*	*7th Unit.*	*8th Unit.*
1927–28 ...	—	—	—	A											
1928–29 ...	—	—	—	A	A										
1929–30 ...	—	—	—	A	A	A									
1930–31 ...	—	—	—	A	A	A	A								
1931–32 ...	—	—	—	A	A	A	A	A							
1932–33 ...	B	—	—	A	A	A	A	A	A						
1933–34 ...	—	B	—	A	A	A	A	A	A	A					
1934–35 ...	—	—	B	A	A	A	A	A	A	A	A				
1935–36 ...	—	—	—	B	A	A	A	A	A	A	A	A			
1936–37 ...	—	—	—	B	B	A	A	A	A	A	A	A	A		
1937–38 ...	—	—	—	B	B	B	A	A	A	A	A	A	A	A	
1938–39 ...	—	—	—	B	B	B	B	A	A	A	A	A	A	A	A
STAGE ...	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15

Stages 1 to 5 are at Serere.

In the above table A indicates S.G.29. The strain B will be chosen at the end of the 1932-33 season.

NYASALAND

REPORT ON THE WORK OF THE COTTON EXPERIMENT STATIONS, SEASON 1930-31.

Summary of Results.

Introduction.

Mr. Ducker, the Corporation's senior officer in Nyasaland, was absent on leave when these reports were drafted. No general review of the experimental results is therefore included, and the reports on the work of the three Stations are signed by the officer responsible in each case.

Makwapala Experiment Station Report for the Season, 1930-31.

by

W. L. MILLER.

Season. The unfavourable distribution of rainfall during the past season has been the primary cause of a big drop in yields of almost every crop grown on the Station. The previous season's good results were produced with a well distributed fall of 32.71 inches. The season under review has had a total of 34.86 inches, just over 21 inches falling during the most important part of the growing season in January and February. Cultivation was impossible owing to excessive rains or intervening dull days, the soil became saturated, causing yellowing and very poor root development. Rain ceased on April 20th, and none has been recorded for over six months to date. A serious shortage of water is threatened in many parts of the country, for tobacco nurseries and domestic use, and feed for cattle is poor.

Cotton.—A mixed bulk of U.4 grown last season yielded an average of nearly 600 lbs. of seed cotton per acre. The yield this season has averaged 300 lbs. per acre, 60% only being strictly No. 1 grade.

Planting conditions and stands were unusually good, and early growth was satisfactory until the prolonged wet period set in, when very little development took place and flowering was delayed until February 11th. Red bollworm attack was rather serious during this period, and a good deal of shedding occurred. There was a slight

increase in flowering up to March 2nd, when a sudden heavy flush appeared, which lasted 28 days and declined rapidly. This decline corresponded with a severe infestation of American bollworm which caused heavy shedding, in addition to the shedding due to poor root systems and the rapid drying out of the soil.

Field Trial.—This was confined to a simple time-of-planting experiment. It has been fairly obvious that cotton must be planted with the first good rains at the Station, but the behaviour of U.4 elsewhere in the neighbourhood made it desirable to find out if the time of planting could be extended.

The plots consisted of four series planted at ten-day intervals from December 12th, five times replicated, and randomised; continuous records were kept of flowering, fruiting, and insect infestation. The results obtained were exaggerated this season. There is probably no significance between the two December plantings, but the yields from January plantings dropped to one half and one tenth respectively of those from the December 12th planting. Results were very similar in a wide range of maize plots planted at weekly intervals over eight weeks.

Rotations.— Tobacco, maize, long term pulses (*Canavalia* and pigeon pea), sunn hemp, partly for seed, partly for green manure, ground nuts and various catch crops of beans were the principal crops grown in rotation.

Tobacco comprised a five-acre bulk of 'Cash', a bright variety for flue-curing, and five plots of approximately one acre each of selections from last season's Western types. The 'Cash' grew too quickly, and conditions were against its standing long enough in the field to produce good leaf. Early yellowing occurred, and the cured leaf was of mixed quality and lacked body.

The Western plots were of considerable interest in the field. Four of them were of good appearance and type, but several off-type plants appeared in one plot. Selfed single plant selections and re-selections have been made in both varieties for further trial, and a large number of leaf measurements recorded.

Maize yielded an average of 2,000 lbs. per acre, which is less than usual.

Pigeon pea, being practically unaffected by the distribution of rainfall, gave a good crop in its second year, though several trial plots of early maturing varieties planted this season almost failed and suffered badly from insect attack.

The uprooting of ground nuts by a simple potato digger attachment to Ransome's R.H.R.L. ridger was very satisfactory.

Soil Conditions.—Except in two corners where seepage occurs, an improvement is being maintained in the soil conditions on the station. Ridge terracing is firmly and satisfactorily established, and the reclaiming of eroded drains is making good progress. The grass planted throughout the building block has practically stopped any run off from that originally serious source of trouble.

The early cover of second year pigeon pea controls any serious movement of surface water during the rains, and the swelling of its penetrating and vigorous root system opens up the soil in a remarkable manner for good late ploughing. This season the crop has been planted as late as February, following tobacco, giving a small top crop, and cut back ready for the coming season.

One-way ploughing has been carried out, and is extremely useful as a means of assisting terracing and correcting the effect of ploughing in a circle, which is a common method in this country.

A year's accumulation of 75 tons of farmyard manure is being applied at the rate of 5 tons an acre to land prepared for maize and dark tobacco.

Port Herald Station, Report for Season 1930/31.

BY

E. LAWRENCE.

Season.—The rainfall this season has been some 4 inches below normal. This slight total shortage would not have made any appreciable difference had the distribution been normal. In March, however, only 1.85 inches fell, instead of the usual 5 to 9 inches, and cotton planted in February and March gave a very poor yield in consequence. The 25 acres on the Station were unfortunately planted in February and the yield of No. 1 grade cotton only averaged about 100 lbs of seed cotton to the acre. Picking commenced on August 31st. Very light mid-season rainfall destroyed all hope of a second flush of flowers and a consequent second crop.

Fortunately, from the lesson learnt last year, the native growers on the lighter land north of Port Herald were encouraged to plant early. Those who did so picked an excellent crop. Those who did not plant until mid February and March have had as poor a yield as the Station has had.

After such seasons as the last two—one when only very early and very late plantings gave a crop and the other when only early planting

succeeded—it is extremely doubtful whether any time-of-planting advice can be safely given to native growers. The wisest course appears to be to plant as early as possible so that a second planting can be carried out if an early drought occurs. From past records an early drought appears to occur less frequently than a late one.

General.— Owing to the need for economy it was impossible to open the 10 acres of "dimba" land this year. Of the twenty 2½-acre fields on the station ten were planted with native food crops and ten with cotton. Only U.4 seed was planted.

Slightly over 2 tons of U.4 seed were distributed this season to 320 growers under the seed multiplication scheme, with the reasonable expectation of receiving back some 20 tons of seed. Owing to the extremely poor yield (most of these gardens were planted during February and March) and to erroneous information that the cotton markets would be only open for a short time, which led to panic selling of every sort of cotton as soon as buying started, it is feared that barely 10 tons will be recovered.

With regard to food crops, an effort has been made to ascertain the most advantageous methods of intercropping, based on the belief that the native will be more readily induced to improve his garden through better methods of interplanting than by adopting a system of rotation. Very little is yet known about intercropping in this country and this year's work was designed to gain some idea of the main problems to be tackled. Some useful pointers have been obtained and next season it is hoped that one or two outstanding problems may be tackled experimentally.

The yield from a 2½ acre field on the Station has formed a useful seed stock of a small red-grained variety of maize, introduced to this country from British Honduras in 1928 by Mr. H. C. Sampson. The grain appears to be practically immune from insect attack and, although the yield was not large, it compared favourably with the native crop in the district which, on the same type of soil, failed entirely.

Field Experiments.—A spacing experiment and a strain test were carried out this season.

In the spacing experiment 12 different spacings were used; the layout adopted consisted of six random strips. The 12 spacings chosen were 6, 12, 18 and 24 inches in rows 3 feet and 4 feet apart, thinned to 2 plants per hole; 24 inches in 3 feet and 4 feet rows, unthinned; and the usual native spacing of 3 feet by 3 feet, in scattered holes, both thinned and unthinned. Mr. R. S. Sennitt, General Manager of the Compagnie Cotonnière du Mozambique, suggested and worked

out the details of the experiment with the writer and has carried out an exactly similar experiment, using the same sized plots (1/30 acre), at Nova Chupanga on the Zambesi River, approximately 50 miles due south of Port Herald. The writer's thanks are due to him for his very welcome advice and assistance.

Yields from the first, and it is feared the only, picking on the Port Herald Station suggest that the 18 and 24 inch spacing in 3 feet rows and the 3 feet by 3 feet native spacing, all thinned, may show some significant advantage over the other spacings.

The strain test included Gatooma U.4 bulk, P.U.4/5-1, P.U.4/5-5 and P.U.4/5-12. (For general characters see "Reports from Experiment Stations 1929/30," p. 315). The layout consisted of six randomised blocks.

Yields from the first, and probably only, picking suggest that, as far as yield only goes, the strain P.U.4/5-12 is inferior to the other three, between which there is very little to choose.

Insect Pests.—The effect of the rain shortage in March overshadowed any insect damage; in any case there has been barely enough cotton on the Station this season to attract insects. Sudan, American, and Spiny Bollworm, Stainer (*Dysdercus* and *Oxycarenus* spp.) and jassid have all been found on the cotton, but in numbers, so small that no appreciable damage has been done.

Aphis attacked the mapira (*Sorghum vulgare*) and did considerable harm, but the cotton escaped damage. Minor pests on cotton this season were two Pentatomid bugs, *Callidea dregei*, Germ. and *Sphaerocoris annulus*, a Noctuid moth, *Egysolis vaillantina*, Stoll. and an Arctiid moth, unidentified.

A Pyralid moth, *Chilo* sp., did tremendous damage to the mapira crop on the Station and throughout the Lower River, boring into the stem just below the developing head which is later attacked and partially or wholly destroyed. Partial control at least would appear to lie in complete destruction of stems after harvest. This is unfortunately contrary to native custom, the stems being usually left until the following November (the crop is harvested in May and June) when fire is put through the whole garden. Natives throughout the district have been advised to destroy the stems directly after harvest and many have done so this year. This stemborer also attacks maize. A Curculionid weevil, *Cyclas compressus*, Hartin, together with a millipede, did considerable damage to the sweet potato crop in the field. The writer is indebted to Mr. Smee, the Government Entomologist, who very kindly identified the various insects mentioned.

Domira Bay Experiment Station, Report for the Season 1930/31.

BY
S. T. HOYLE.

General.—A two storied dwelling house with a garage and a general utility store have been built this year. At the time of writing they were not quite finished, but it is hoped that they will be completed before the rains begin.

Thirty acres of new land have been cleared, but not stumped. Most of the clearing was done by Mr. Walkington, of Chitala estate, who took the wood in payment. The new land is very similar to that cleared last year, good in parts but suffering from waterlogging. It is quite typical of the surrounding country.

The water supply of the station is adequate, but not very satisfactory. The water level in a well dug last year near the bed of a dry stream fell to under one foot by September, and deepening by a foot did not effect an increase in the depth of water. Water is obtained from holes dug in the bed of the stream and it is thought that the lack of water in the well is due to the difficulty of seepage through the brick lining which was laid in cement. The well near the house site has been taken down to a depth of 65 feet through rock which necessitated blasting and there are indications that water is not far off.

Season.—As will be seen from the accompanying diagram, most of the rain fell in January which was followed by a period of insufficient rainfall. The fields on the station are nearly level and there is little or no fear of erosion. But this very flatness is a disadvantage in times of heavy rain. The surface drainage being slow, the soil particles become deflocculated and the water seeps away so slowly that the area becomes virtually waterlogged. Extreme examples of this are found in the depressions in the fields and surrounding country, where water may lie about as late as June. The new fields this year were particularly bad in this respect and for the latter half of January a large proportion of the thirty acres was under water. The result of this waterlogging when root development was taking place was to cause the roots to run along the ridges and in the subsequent dry weather the plants were unable to make much growth, many of them being stunted and bearing only three or four bolls or less. The whole of the new land was planted with bulk U.4 and yielded an average of 297 lbs seed cotton per acre which cannot be considered bad under the circumstances. Some contour drains have been put in this year and it is hoped that

the trouble will not recur. The labour supply was deficient and the weeds got the upper hand for a time, which probably contributed to the low yield.

The rest of the station was planted with small bulks and small plots. The yields for the small bulks were as follows :—

Cambodia	134 lbs seed cotton/acre
Over-the-Top ...	216 „ „ „ „
U.4/2	481 „ „ „ „
U.4/4/2	330 „ „ „ „
U.4 (bulk)	290 „ „ „ „

The three strains of U.4 in the above table were sown with seed sent from Barberton.

U.4 shows up very well in comparison with the other two varieties, though this may be largely a seasonal effect. The comparative drought in February-March when the growth of cotton was almost at a standstill would favour a variety with a short growing period. Strain tests of the various U.4's will be planted this season.

The small plots consisted of a few selections from Barberton and a number from Makwapala, some of which appeared promising. In addition, some types submitted for trial by Dr. Harland was planted, but most of these appeared unsuited to their environment. Those that set seed will be planted again this season.

Insect pests. Stainer was first seen in February, but was not numerous until the middle of March when flowering was in full progress. The first and last pickings showed very little sign of staining. The bulk of the cotton had about 25% damaged cotton, mostly due to stainer and the rest due to bollworm.

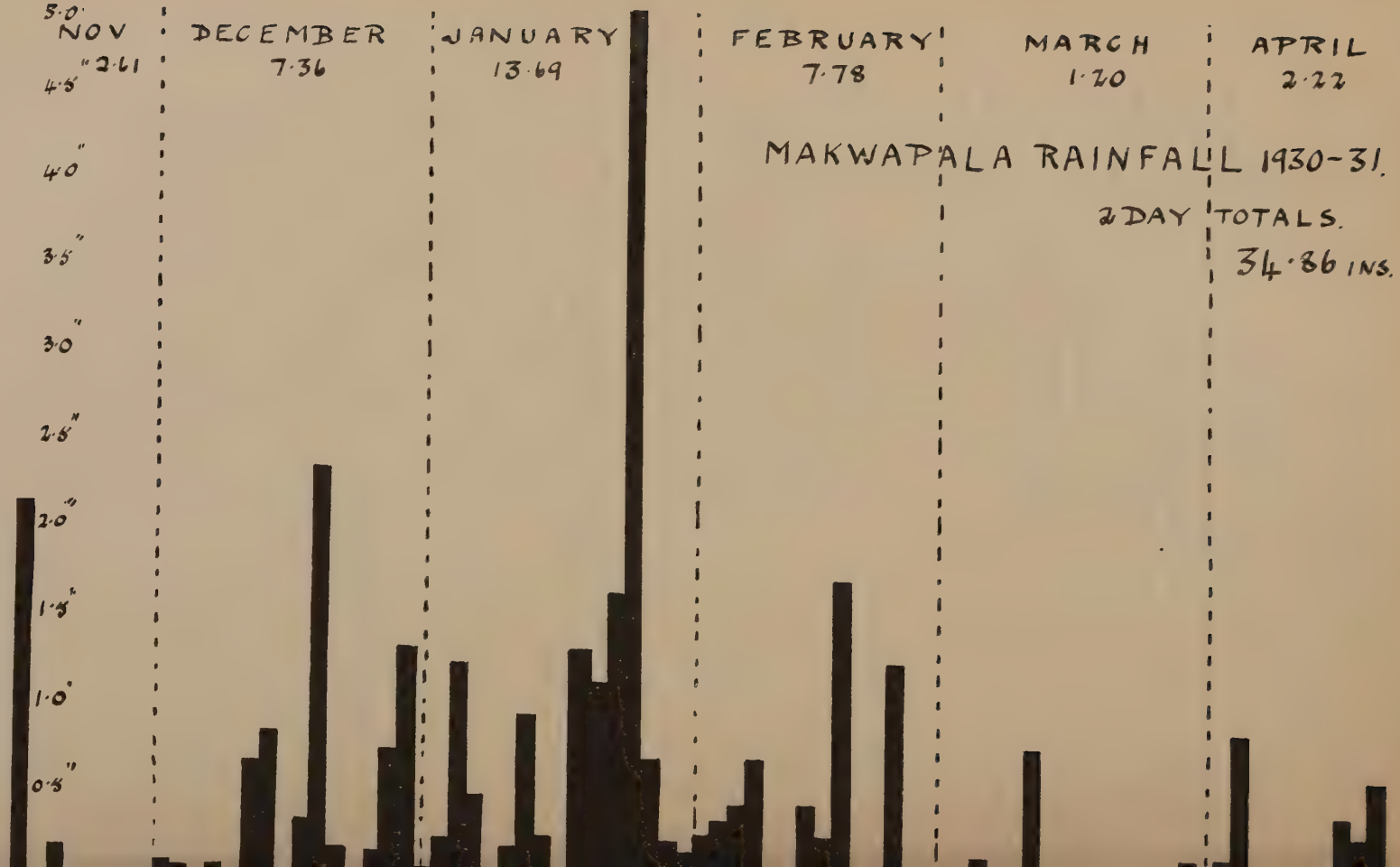
Bollworm.—Bi-weekly counts were made on the bulk U.4 and the Red, American and Spiny bollworms were all found. The Red bollworm was much the most common species and its greatest incidence was in April, falling off in May and June. American and Spiny bollworms were found sporadically in small numbers during the whole of the season. The proportion of sheddings due to bollworm was fairly constant thoughout the season. Non-bollworm sheddings, always smaller in number, decreased from the middle of April onwards.

Jassid.—This pest was present, but not in sufficient numbers to do any visible harm. U.4 showed considerable reddening of the leaves but did not appear to be affected in any other way. Some of the Makwapala selections were noticeably free in this respect. A few rows of jassid-susceptible Foster-Whithall-G were rather stunted, but set quite a fair crop.

Lilongwe.

A few observation plots of U.4, Cambodia and Over-the-Top were planted in this area. Owing to frosts, which begin towards the end of May or early June, earliness is of prime importance, and in this respect U.4 has a decided advantage over Cambodia and to a lesser degree over Over-the-Top. Some bulk selections have been made which will be planted on the Government experiment station this year together with some early selections made on the station.

Pests of all sorts were conspicuous by their absence, presumably due to the fact that cotton is not yet one of the normal crops in this district.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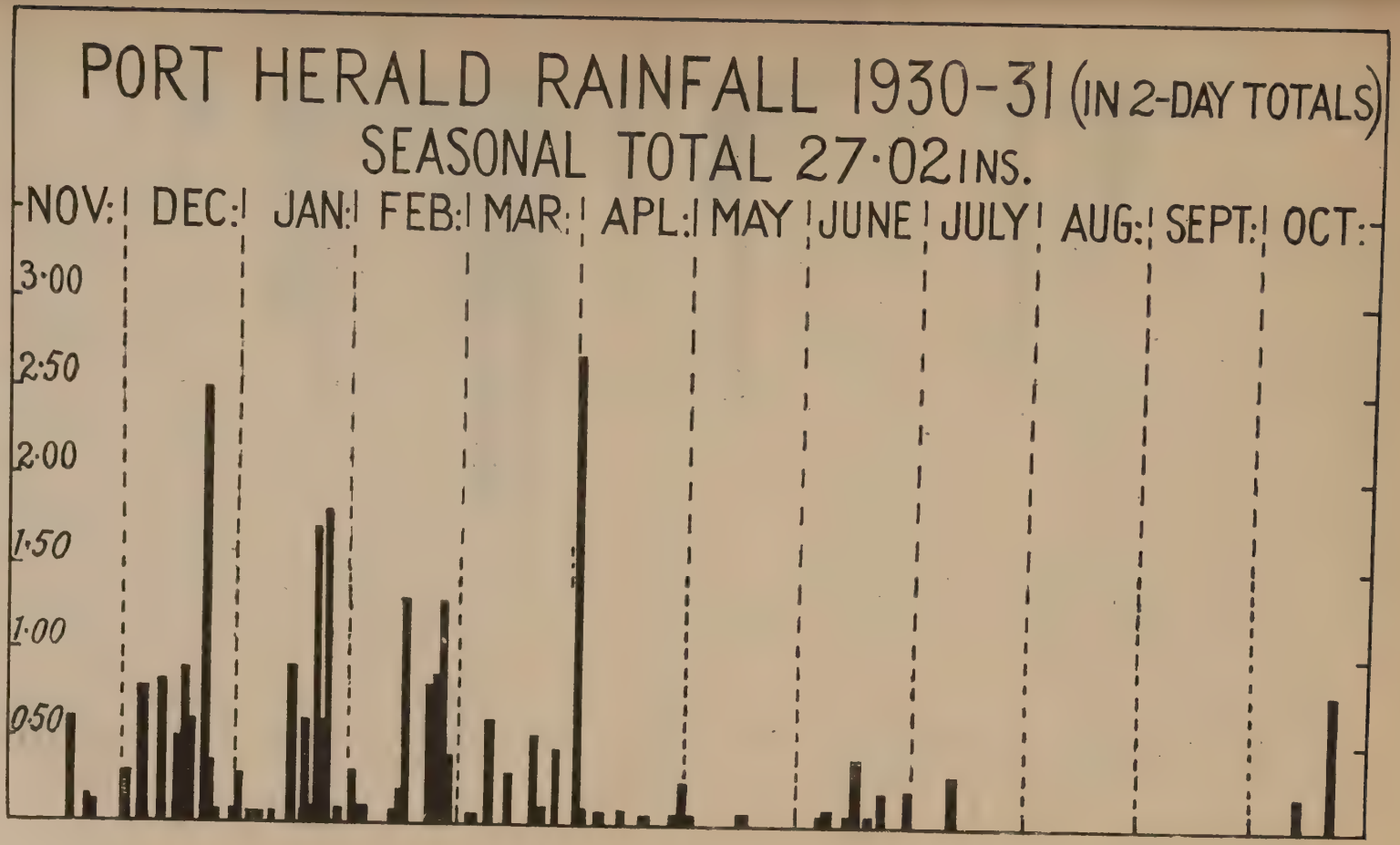
MAKWAPALA RAINFALL 1930-31.
2 DAY TOTALS.
34·86 INS.


PORT HERALD RAINFALL 1930-31 (IN 2-DAY TOTALS)
SEASONAL TOTAL 27·02 INS.
NOV:
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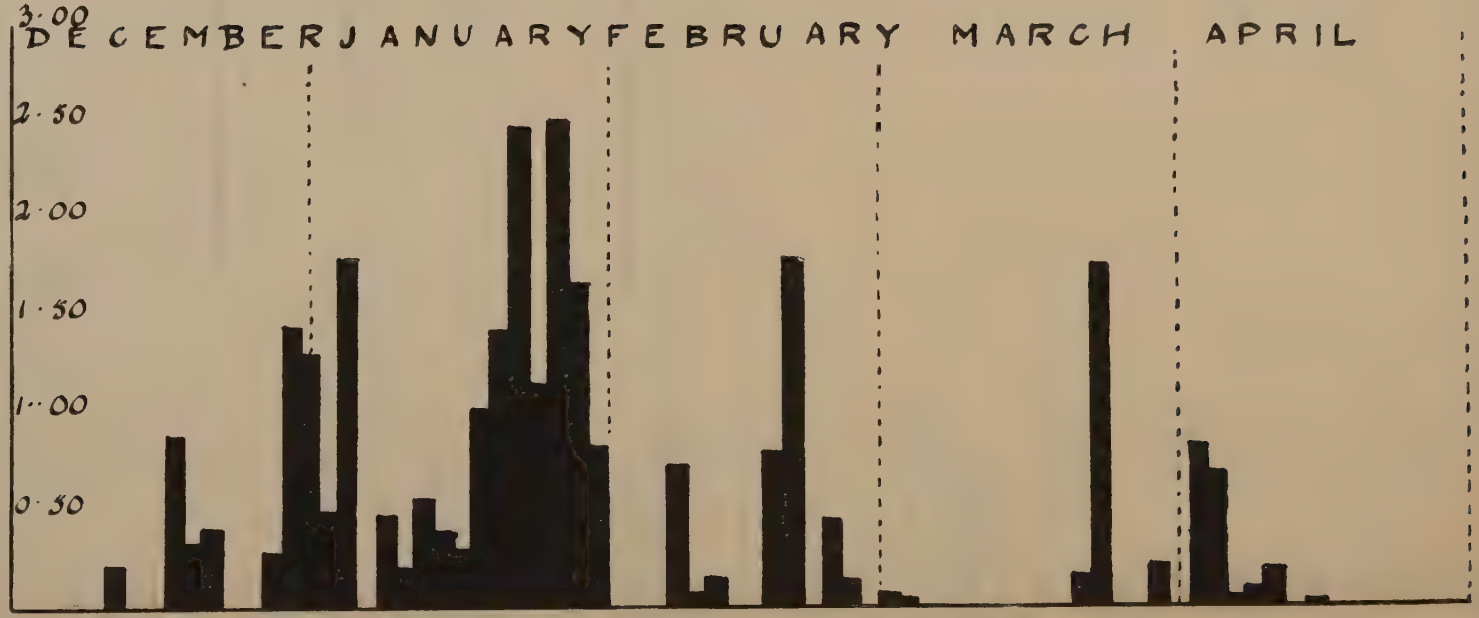
DOMIRA BAY RAINFALL 2DAY TOTALS 1930-31

28·02INS



NIGERIA

SUMMARY OF THE WORK CARRIED OUT AT THE CORPORATION'S SEED FARM, DAUDAWA, NORTHERN NIGERIA, DURING THE YEAR 1931.

BY
G. BROWNE.

In presenting this summary of the work carried out at Daudawa during the past year, the principal operations on the farm are dealt with quite briefly in separate paragraphs, but rather a fuller account is given of the cotton crop, in view of the fact that this constitutes the main purpose of the farm.

Clearing.

A further 220 acres have been added to the farm, bringing the total cleared area up to 900 acres. The new land is satisfactory and contains very few outcrops of stone; the bush on it, however, was unfortunately exceptionally dense.

Cultivation (Breaking Land).

In order to set more labour free for other work after the rains have broken, an attempt was made to get as much land as possible broken in the dry season. The soil is so extraordinarily hard, however, that the work is slow and laborious. It was begun in November 1930 and carried on until June 1931. Both mechanical haulage and cattle were used for the ploughs, and about 80 acres were broken by these means. A further 140 acres were broken by hand.

Crops.

Cotton.—It was reported last year that the 1930-31 crop, grown from the seed supplied by the Department of Agriculture and known as Strain D, suffered considerably from jassid. The earlier planted fields were the first to be attacked, and they also suffered the most damage. The Co-operative Farms also did not escape, but there the attack was comparatively light. Altogether most of the fields suffered,

and from about 100 out of the 500 acres very little cotton was picked. The average yield from the main farm was 220 lbs. per acre against last year's average of 284 lbs. per acre. The highest average of any one field was 360 lbs. per acre against that of 433 lbs. per acre last year. The lint returns were 33,851 lbs. No. 1 quality and 2,078 lbs. No. 2. Both were sent home and sold there.

Owing to the apparent susceptibility to jassid of the strain D. cotton, the Agricultural Department decided that, for this year at any rate, the seed from this cotton should not be propagated further. It was accordingly distributed among those Agricultural Stations at which cattle are kept, including Daudawa.

With a view to finding a more jassid-resistant strain, the Agricultural Department obtained the assent of the Corporation to tests of other varieties being carried out at Daudawa. Four new strains were planted, each occupying approximately a 20-acre block, while as a comparison another block of Strain D. was also planted. Each variety will be grown, harvested and ginned separately, general observation being kept upon them throughout the season. Fields lending themselves to isolation were chosen for the different strains. The objects of the test are as follows :—(1) To get a better indication of the behaviour of the different strains when grown at Daudawa as compared with Samaru and Maigana, especially as regards jassid resistance ; (2) By ginning the lint on the Corporation's gin running at a commercial speed (as against the hand gin at Samaru), to obtain more reliable comparative results from both the ginning tests and the broker's valuation : (3) In the event of any one or more of these strains being considered suitable for further reproduction, a considerable quantity of seed would be obtained next season, thus saving a year in the ultimate multiplication scheme. The new strains chosen are those known as H.21-3, J., G., and U.4. The seed rate for these blocks was 10 lbs. per acre. The rest of the farm was planted with ordinary B.C.G.A. commercial seed from Funtua ginnery at a rate of 15 lbs. per acre.

The state of the various strains at the time of writing (November) is as follows :—

U.4	...	Moderate growth, some stem borer and leaf damage, quantity of jassids present, but no characteristic damage, fairly heavy fruiting.
Strain J.	...	Medium growth, patchy, slight leaf roll damage, a few jassid flies about, good fruiting.
Strain G.	...	Below medium growth, slight leaf roll damage, few jassids present and poor fruiting.

Strain H.21-3. ...	Moderate growth, leaf roll, crinkle, few jassids present, but no damage, moderate fruiting.
Strain D. ...	Normal growth, leaf roll, jassids present, but no actual damage as yet, good fruiting.
B.C.G.A. Seed...	Normal growth, extensive leaf roll and jassid damage on parts of newly cleared farm, quantity of jassids present, but no damage on old farm as yet, fruiting fairly heavy but patchy.

A dry period in early July delayed commencement of planting to a later date than had been planned originally, while heavy rains at the end of the month and also during August and September caused serious erosion on those parts of the farm where this usually happens. Attempts to counter this by ridging were fairly successful in some cases. The best means of overcoming erosion is a difficult problem, and perhaps terracing is the most successful method, though this is not always certain and to carry it out at Daudawa would entail a good deal of expenditure.

To sum up, the stand of the cotton crop is excellent over all the farm ; insect and other damage is, at the moment, below the average, and given favourable conditions during the next two months, a heavier crop than usual ought to be harvested.

A considerable quantity of cereals must be grown annually to provide food for native labour and for cattle, and as these cereals take up a fairly large area of land, it was thought that at all events a portion of them might be grown preceding cotton on the same land. Guinea corn was out of the question, as it matures too late in the season, so bulrush millet was selected for the experiment, the object of which was to find out whether a catch crop of millet would reduce the subsequent yield of cotton, and if so, whether the reduction in yield would be compensated by the cotton that could be grown on that area which otherwise would have had a crop of cereals grown upon it. The average number of bundles of millet per acre from the experimental plot was 20½ against an average of 19 bundles per acre from the three best fields on the farm planted wholly in cereals. The figures for the cotton yields will not be available for some three months yet.

Beans.—There are 180 acres under this crop during the present season, planted in May and June. Despite rather poor germination, quite a good cover crop was on the ground when the time came for ridging the beans in. Two fields (40 acres) which had been planted later and had only a very poor cover by September were left for seed

and have since then come forward very well. This acreage should be more than ample for next year's requirements.

Millet.—For the first time a really good crop of millet was harvested, 104 acres were grown, which included the 8 acres mentioned in connection with the experiment on growing millet as a catch crop immediately preceding cotton. The crop yielded an average of over 600 lbs. per acre over the area planted, which included many patches of poor land.

Guinea-corn.—This crop was grown on 96 acres of the same land as the millet, with the exception of the 8 acres of the latter included in the experiment mentioned above.

The crop had not reached maturity when this Report was written, but it can be safely said that a record crop is expected.

Labour.

Owing to the general trade depression, there is a marked excess of labour available over requirements. The institution of cattle cultivation also reduces considerably the number of men required to work a station of this size, though at the busiest seasons such as planting, clearing, picking and harvesting, the number of men employed has to be largely increased. During the last two years there has been no difficulty in obtaining all the labour required.

Many of the original employees are still working on the farm and constitute the basis of the permanent labour staff. Co-operative farmers also form an increasing proportion of the permanent labour supply. In order to keep as many men employed as possible, a system of short time is being worked: this apparently gives satisfaction to the labourers, giving them time to attend to their own patches of farm and to visit the local market. Almost all the men who have been here for any length of time have their own little plots of corn, which they cultivate in the evenings and on off-days. This is naturally encouraged, as it increases and cheapens the food supply locally, besides being a means of retaining the type of man that is wanted.

There has been no outbreak of any form of disease in the camp, and beyond an occasional case of guineaworm (usually a new-comer), there is little sickness to be recorded. The average daily attendance on the farm has been 199, which is a slight increase on last year's average, while a census showed a population in the camp of almost 500 persons resident in the labour camp.

Cattle and Stock.

At the time of writing the last report, there were 25 cattle at Daudawa, and there had been three deaths since the herd was started. There are now 35, of which 5 are heifers, 3 of them in calf. Unfortunately there have been 13 deaths during the last 12 months. It must be admitted that a mistake was made in yielding to the temptation of the low prices ruling to buy likely-looking animals locally from traders or passing Fulani graziers. In addition, all the sickness which has troubled the herd from time to time has been traced to these local purchases, and the great majority of the deaths have been among them also.

The principal disease has been trypanosomiasis caused by tsetse-fly infection. The Veterinary Officers state that while most cattle here have trypanosomes in their blood in some degree or other, the tsetse-fly itself is most difficult to find, and very few indeed have in fact been found. An isolation kraal was built at a considerable distance from the cattle sheds, and here newly purchased cattle are kept for about a fortnight until it is seen whether they are normally healthy. It is also useful for sick cattle and suspected cases.

In the work on the cotton crop alone the cattle broke 40 acres, ridged up 190 acres, re-ridged after the crop was sown 400 acres, and cultivated 30 acres. They also ridged up 60 acres of cereals, and cultivated 40 acres of beans, making 760 acres altogether. They are also employed daily in miscellaneous carting work about the farm.

Over 1,100 Fulani cattle grazed on the cotton sticks after picking was completed. They were kraaled on selected sites in fields in which it was thought the land would benefit most. Four fields, i.e., 80 acres, were given a dressing of approximately 1 ton of F.Y.M. to the acre. Field 5, which has always been considered the worst field on the farm, had a dressing of F.Y.M. last year as well as having Fulani cattle night-kraaled upon it, and this year it contains by far the best crop of cotton yet seen there.

Considerable local interest in cattle work is being taken by the surrounding native farmers, some of whom come some distance to see this method of cultivation.

The Ginnery.

A new Dobson and Barlow 40-saw gin was erected towards the end of last year. A total of 129,903 lbs. of seed cotton was passed through the ginnery, and this produced 35,929 lbs. of lint, 84,100 lbs. of seed, and 874 lbs. of waste.

Waterworks.

The annual extension of the pipe line has supplied another four farms. Several attempts have been made to sink wells at different places, in the hope of making water available for separate cattle sheds without having to bring it to the site in pipes. Depths of 60 and 70 feet have been reached, but no appreciable signs of water have as yet been found.

Buildings.

A new half-size standard store was put up near the ginnery. This will prove invaluable during the cotton picking and ginning season.

Nine new labourers' houses have been built, and many were re-roofed during the last dry season. A new stable has been built to replace the one burnt out, as well as a new grain store.

Co-operative Farms.

At the time of writing last year's Report twelve farms were fully occupied, and another four had been added to the scheme, though no houses had been built on them. The four houses have since been built for these farms, together with a house for another farm which up to that time had not been tenanted.

Six more farms have since been cleared and cropped: the land on them is exceptionally good, and there are upwards of twenty applicants for them already. These farms are bearing excellent crops of cotton and cereals at the moment, and houses are in process of being built. There will thus be 22 farms in all at the end of this year. The estimated area under cotton on the Co-operative farms at present is 60 acres, and this would have been greater had the cotton prices been better.

Last year the Co-operative farms had 45 acres under cotton, and these averaged 242 lbs. per acre, as against 220 lbs. per acre on the main farm, where jassid damage, however, was more severe.

Cattle cultivation has not made much headway as yet with the farmers. They have been deterred by the heavy mortality among the cattle, the reason for which has been mentioned above. Moreover, the price of cotton this year is not sufficiently attractive to stimulate the farmer to expend money on new forms of cultivation.

Meteorological Notes.

The first rain fell on March 30th, and during the early part of the wet season the falls were irregular and occasionally exceptionally

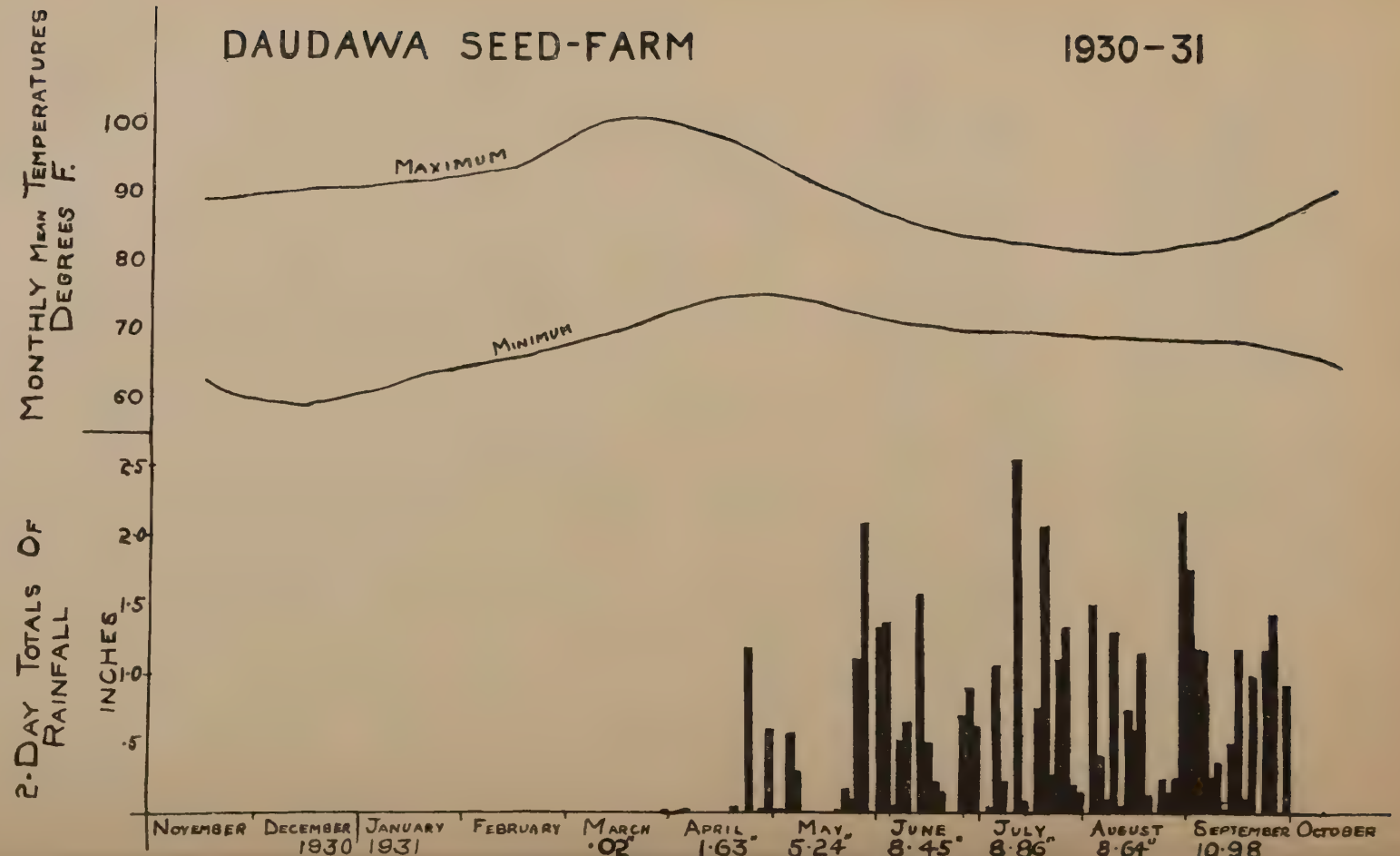
heavy. In the latter part of August and during September, heavy rains were again recorded, which caused erosion and wash on many parts of the farm. The rains ended early, none falling after the end of September. The total rainfall for the year was 43.82 inches, which is just about normal, though higher than last season, which was exceptionally low. The harmattan commenced early in October, which is much sooner than usual.

General.

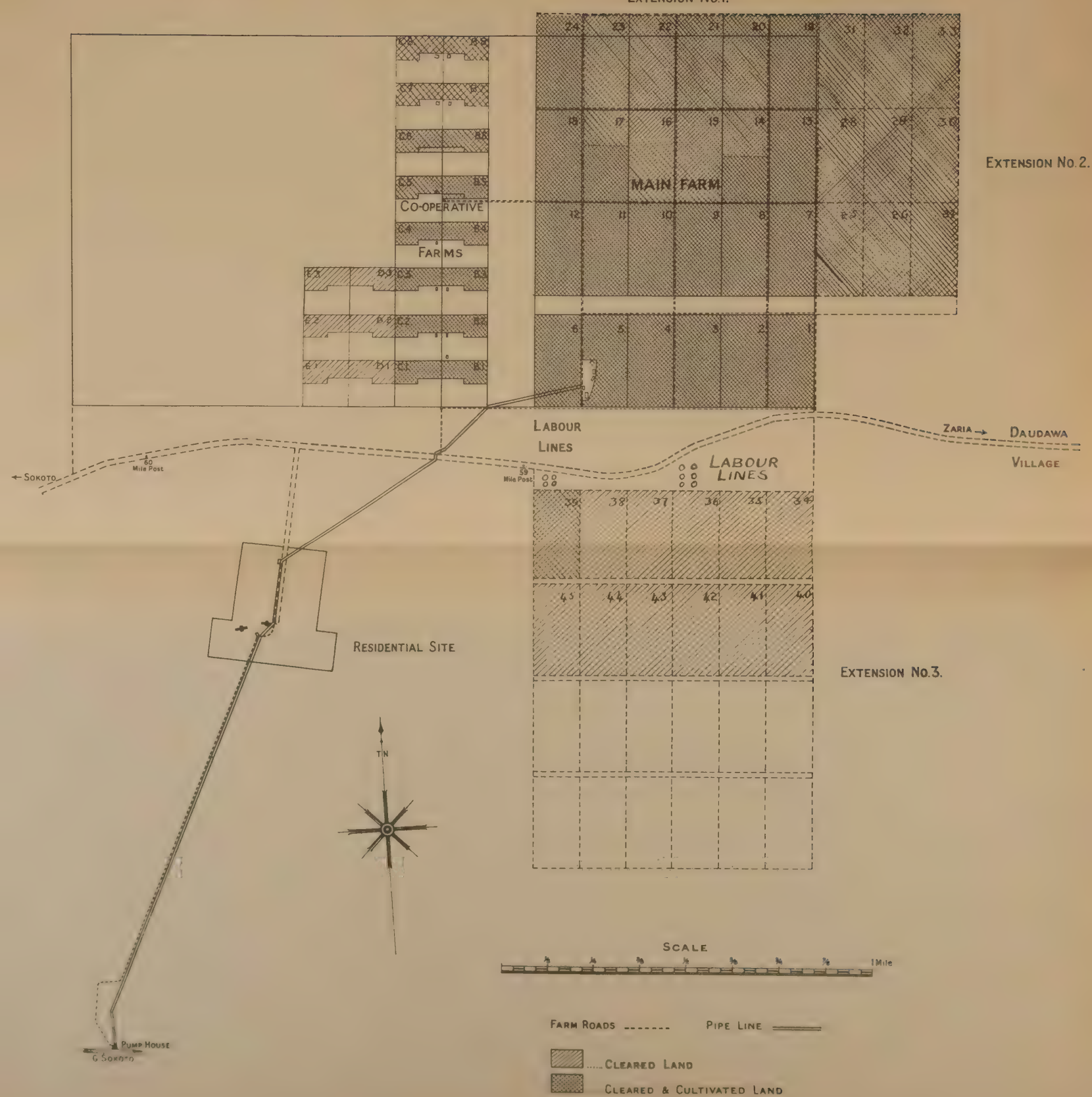
A new road has been built connecting Daudawa with the railway station at Shemi, about six miles away. A level crossing has also been put down, which greatly facilitates the approach of our lorries to the freight sidings.

This opportunity is taken of thanking the Officers of the Political, Agricultural and Veterinary Services for their kind advice and assistance throughout the year.

DAUDAWA SEED-FARM 1930-31



DAUDAWA SEED FARM. 1931.



[*Included by courtesy of the Iraq Government.*]

IRAQ

REPORT ON THE WORK ON COTTON OF THE CENTRAL EXPERIMENT STATION AT RUSTAM (NEAR BAGHDAD) FOR THE SEASONS 1929, 1930 AND 1931

BY
EVAN GUEST.

SUMMARY.

This report covers the period of the last three cotton seasons, but it should be noted that at the time of writing the present season (1931) is barely over, and that various laboratory measurements and calculations are not completed. The period has been one of considerable difficulty owing to financial stringency and frequent changes of staff. Another difficulty felt very seriously at Rustam is the extreme salinity of the summer irrigation water. The land on which the farm is situated is rather poor, difficult to work and not very uniform; these features are now accentuated by the high salt content of many areas. The conditions are far from ideal for experimental work and are reflected in the high probable errors of nearly all the experiments conducted at this station.

In Iraq cotton has to contend with fairly rigorous extremes of climate, being liable to be checked by cold at the beginning of the season and by extreme heat and dryness later on.

The most serious pest of cotton is the spotted bollworm (*Earias insulana*) which causes much damage to the crop each year. It is controlled to some extent by hand collection during the early part of the season, and by cutting out and burning the cotton sticks and ploughing up the land at the end of the year. In 1930 and 1931 a dusting experiment with sodium fluosilicate for the control of bollworm was carried out at Rustam. Dusting was shown to reduce the percentage of infestation but it is doubtful whether the effect is sufficient to render the operation economic. An Aleurodid fly similar to those reported in the Punjab and in the Sudan is found on cotton in Iraq; up to the present it has not done much damage. The annual depredations of the Moroccan locust in the north are the chief factor which prevents the extension of cotton-growing in that area. The Nejdi locust is not indigenous in Iraq though periodic visitations occur of swarms from neighbouring countries. These swarms sometimes

manage to establish themselves and overrun the country for a season or two, but eventually they die out. In 1929 and 1930 considerable damage was done by this locust; and fear of this pest has been one of the primary causes of the reduction of the area under cotton in Iraq during the last few years.

The average yield of cotton on the propagation areas of the farm since 1926 amounts to 750 lbs. of seed-cotton per acre and it is considered that at least this yield should be obtainable on private farms, where the land and the irrigation water are often better than at Rustam.

Mesowhite cotton still continues to be the chief variety grown in Iraq although a fair quantity of Iraqi cotton (*G. herbaceum*) is grown and sold locally, chiefly for stuffing mattresses. Though newly selected strains have gradually replaced the original, no new variety of cotton has yet been established as superior to Mesowhite, the chief defect of which is its low ginning percentage. Recently a new cross-bred strain, R 124, which has a higher ginning percentage and a similar quality of lint, has been doing well at Rustam, while Acala has been shown to give a much higher yield than Mesowhite in the varietal test for the last two years. This cotton has a high ginning out-turn, but a poorer quality of lint, and it is doubtful whether it would be advisable to grow it in place of Mesowhite. Owing to lack of funds it has been necessary to reduce very drastically the number of plant selections and cross-bred strains. The main object of the present programme is to maintain the purity and quality of Mesowhite cotton and at the same time to improve the ginning percentage by further selection.

The date-of-sowing test, which was concluded in 1929, showed conclusively that the best season for sowing cotton was between the middle of March and the middle of April; the final yield obtained from sowings in May and onwards falls off abruptly.

A cultivation test with various types of interculture has given somewhat conflicting results. A small disc cultivator for use between the cotton ridges has been devised and is now under trial.

The results of thinning and spacing experiments carried out some years ago, but not published, are briefly summarised. As a result of these experiments, a spacing of 36 inches by 15 inches was adopted at Rustam. The ill effect of delayed thinning was demonstrated, and thinning the crop to two plants per hill was shown to be most satisfactory.

The results of a manurial test with cotton in 1929 were inconclusive owing to a high degree of experimental error. Sufficient funds were not available to enable this experiment to be repeated during the last two seasons.

Wheat and barley are the principal rotation crops grown with cotton. It is usual to give two bare fallows, and the normal rotation takes three years. Owing to the overlapping of the seasons for summer and winter crops it is not easy to find a satisfactory green manure, but berseem is fairly suitable for this purpose. A periodic bare fallow is necessary to preserve the texture of the soil. Superior varieties of wheat and barley have been issued by the Department and lately the cultivation of linseed has been introduced and is rapidly becoming popular.

Introduction.

During recent years the activities on the government farm at Rustam have been drastically reduced owing to financial stringency. The work of the last few seasons has been particularly difficult to handle, with a gradually diminishing budget and a steadily diminishing staff. Many lines of work which were initiated by the former Cotton Breeder, Mr. Sawhney, have had to be abandoned so as to bring the cotton programme within the compass of what can be achieved with the present facilities.

For many years the cotton section at Rustam had been under the charge of the late Cotton Breeder, Mr. Kalidas Sawhney, who prior to his departure to take up an appointment in India in March, 1929, had laid down the programme for that season. This programme was carried out by his former assistant Khalil Effendi Urfali under the direction of the writer. The vacant post of Cotton Breeder was filled in 1930 by Darwish Beg Haidari, who had recently come to Rustam after completing a course of study at the Agricultural and Mechanical College of Texas. His difficulties were increased by the departure of the two assistants in the middle of the cotton season, thus leaving him without any assistance. These posts have not been filled.

The Central Experiment Station—Rustam.

As this is the first report which has been published in this series it is as well to give some description of the Central Experiment Station at Rustam. This station, which is now the only government farm in Iraq, is situated on the Diyala river nine miles east of Baghdad, and about three miles above the junction of that river with the Tigris. It was established in 1920 at the same time as a number of subsidiary farms in the provinces. All these other farms have now been abolished and Rustam has simultaneously to serve the purposes of an experimental station, a propagation area, and a demonstration farm. The total area of the farm is about 1,000 acres, but during the last two years,

owing to budget reductions, it has only been possible to cultivate a small part of this area. Cotton is the principal summer crop, wheat and barley the chief winter crops. The other summer crops grown on the farm are maize, Deccan hemp, cowpeas, sunflower and castor-oil. Other winter crops include linseed, rape, berseem, local "vetch," broad beans and oats. Previous to the opening of the government farm at Rustam, the greater part of the land had been under intermittent cultivation for a number of years, except for the extreme western end furthest from the river, which was liable to inundation by the floods of the Tigris in pre-war days. The Arabs used to grow a few summer vegetables along the river bank, and their crops of barley and wheat on the inland stretches where free-flow water was available in the canals during the flood season. Most of the land at Rustam is not very good and is difficult to work into a fine tilth. On a general average the soil contains about 22% of fine sand, about 57% of coarse and fine silt, and about 17% of clay, and is poor in organic matter. The available nitrogen is less than 0·1%. The soil has a low water-holding capacity and after irrigation forms a hard crust which cracks as it dries.

A serious problem at Rustam has been the steady accumulation of salts after summer irrigation. This problem has been recognised for some time, but it has lately become acute owing to the fact that the salt content of certain areas on the farm is now high enough to affect plant growth seriously, particularly on the former Research Area where the land was more continuously cropped than elsewhere, so that it has lately become necessary to lay out the experiments in a new area which is more or less free from salt.

Prior to the opening of the government farm at Rustam, the salt content of Diyala water was found to be comparatively low and did not exceed 20–30 parts per 100,000, at any time of the year, a figure equivalent to the normal salt content of the Tigris. Analyses were continued regularly month by month after the inauguration of the farm, and in subsequent years it was found that the salt content of the Diyala, from which the Rustam pumps derived their supply of irrigation water, increased during the period July to October to from 200 to 300 parts of soluble salts per 100,000, of which not far short of one-half was sodium chloride. It was then discovered that before the war the Arabs had been accustomed to erect a temporary dam each summer at Table Mountain so as to keep up the level of water in the canals which flow from the Diyala in the Baqubah fruit-growing area. This custom, which dated from time immemorial, had been allowed to lapse during the war and the disturbed years which followed it (when the original analyses were made) but was re-adopted in 1921, the year after the

inauguration of Rustam. The Irrigation Department was eventually obliged to build a permanent barrage at this point on the river. The result is that little or no fresh water flows down the Diyala during the summer months, and the lower reaches merely act as a drain into which the seepage waters of the Baqubah gardens percolate. Much of this land is highly saline and as the river falls the concentration rises, with the result that the salt-content in the lower reaches where Rustam is situated goes up by leaps and bounds.

TABLE I.

MEAN MONTHLY SALT CONTENT OF IRRIGATION WATER AT RUSTAM (1924–1930).

Month.	*Salt content of water in parts per* 100,000.				*Month.*	*Salt content of water in parts per* 100,000.			
	Water from Diyala river at Rustam.		*Water from the Tigris for comparison.*			*Water from Diyala river at Rustam.*		*Water from the Tigris for comparison.*	
	Total Salts (including sodium chloride).	*Sodium chloride alone.*	*Total Salts (including sodium chloride).*	*Sodium chloride alone.*		*Total salts (including sodium chloride).*	*Sodium chloride alone.*	*Total salts (including sodium chloride).*	*Sodium chloride alone.*
January ...	36	5	26	3	July ...	167	69	23	3
February ...	36	4	26	3	August ...	217	94	28	5
March ...	27	3	22	2	September	238	105	30	5
April ...	25	3	19	2	October ...	270	115	32	5
May ...	29	4	19	2	November...	151	45	33	5
June ...	55	16	19	2	December...	83	20	27	3

Samples of water were taken from each river on the 15th of each month during this period. The maximum was reached in October, 1930, when the salt content of the Diyala actually rose to 380 parts per 100,000, of which 172 were sodium chloride.

It has thus come about that a serious accumulation of salts has been taking place at Rustam during the last ten years. Two possible remedies have been suggested. One is the removal of the pumping plant from the Diyala to the banks of the Tigris, a few miles distant, and the construction of a high level canal to bring Tigris water to Rustam. This scheme has always been rejected or deferred by the Government on account of the capital expenditure involved. The other proposal is to wash out the salt where it has accumulated. This is done by prolonged flooding of the land and drainage at the season when the river is high (thus necessitating only a slight lift) and its water is sweet. The method is sometimes known as "colmatage." It has been tried at Rustam with partial success, but the cost of washing even a small area is high.

Climate.

Most of the cotton in Iraq is grown in the alluvial plain of Mesopotamia through which the Tigris and Euphrates flow south of the Jebel Hamrin. A little cotton is also grown in the sub-montane area of the north near Mosul and Kirkuk, but this is nearly all Iraqi cotton (*G. herbaceum*) the lint of which is used for stuffing local mattresses and pillows and not for export for spinning. The climate of Baghdad may be taken as typical of the whole Mesopotamian plain. The summer humidity is rather greater in the neighbourhood of Basrah and the Persian Gulf and the winter rainfall becomes heavier towards the northern hills; otherwise the climate of the whole area is much alike. Meteorological data recorded at Rustam during the last nine years are given in Table II.

TABLE II.

Meteorological Data at Rustam (Mean 1922–30).

Month.	*Rainfall* (in inches).*	*Mean daily maximum temperature. (°F.)*	*Mean daily minimum temperature. (°F.)*	*Maximum temperature. (°F.)*	*Minimum temperature. (°F.)*	*Mean percentage of relative humidity at*		*Mean daily evaporation† (inches).*
						8 a.m.	*4 p.m.*	
January...	1·1	62	36	70	26	88%	53%	0·05
February	1·1	66	38	76	28	85%	48%	0·06
March ...	0·5	76	46	91	32	65%	35%	0·14
April ...	0·3	88	54	101	42	50%	24%	0·19
May ...	0·1	101	63	111	53	32%	18%	0·27
June ...	0·1	106	69	114	61	30%	17%	0·31
July ...	nil	111	73	118	65	29%	16%	0·32
August ...	nil	107	66	117	57	33%	17%	0·27
September	nil	106	64	116	55	35%	19%	0·23
October...	0·1	95	55	107	43	46%	26%	0·16
November	1·1	80	48	93	38	71%	46%	0·09
December	0·8	67	40	77	28	86%	57%	0·04

*Total rainfall for the year = about 5 inches.

†Daily evaporation not recorded before 1929; mean 1929–30 is given.

Meteorological records are also kept by the Royal Air Force at Hinaidi aerodrome, which adjoins the farm. Although the distance separating these two stations is only two or three miles, a considerable difference in temperature is often recorded. During the height of summer the daily maximum at Rustam is usually about 4° lower than at Hinaidi. This difference is accounted for by the presence of irrigated crops and trees at Rustam; at Hinaidi the ground is mostly bare, except for a few small gardens.

Cotton is grown as a summer crop. It is planted in March and cut out in December. On the whole, the conditions with which the crop has to contend are fairly rigorous. There is first the danger of late

frosts or cold winds at the end of March, which may check the young plants. Then about the middle of April a sudden change occurs and winter often passes into summer almost without warning. Hot dry winds in April may succeed the cold winds of March, dust-storms smother the crop in May and June, and extreme heat and dryness check it in July and August. The water requirements of cotton during the different periods of the season are indicated by the number of irrigations given during each month. This is roughly as follows :— March, 1 or 2 (including the pre-sowing irrigation) ; April, 1 or 2 ; May, 2 or 3 ; June, 3 or 4 ; July, 4 ; August, 4 ; September, 2 or 3 ; October, 1 or 2 ; the total number during the season being about 18. In some seasons irrigation could be discontinued in September without entailing much loss of crop.

The chief features of each of the three seasons under review are noted below (see also Figs. 1, 2, and 3 at end of the Report).

1929.—After an unusually dry winter rather low humidity combined with cold winds in March did not favour the germination of the crop. The growth of the young plants was later retarded by dry winds in April and the germination of the late sown cotton was interfered with by a late shower just after re-sowing which caused the soil to cake. The crop did not make much progress till towards the end of May when the rise in temperature induced the plants to grow rapidly. The prevailing feature of the season was the frequency in June and July of dust storms, smothering the cotton with dust which clung to the leaves and dirtied the early-opening bolls. At the same time the lack of wind and rather high humidity during these months encouraged the multiplication of white fly. High temperatures and hot scorching winds necessitated frequent irrigation from August onward and induced much bud- and boll-shedding. Conditions were on the whole favourable to the multiplication of the spotted bollworm which did considerable damage to the crop and destroyed almost the whole of the second flush.

1930.—This was a better season for cotton. At sowing time the weather was favourable, being warm and relatively humid. Germination was nearly perfect and little re-sowing was necessary. Although the winter had been mild, the infestation of bollworm was slight, both at Rustam and in the districts.

1931.—Winter rainfall was a little below average and the percentage of humidity at sowing time was slightly lower than usual. Dry winds and dust-storms also interfered with the germination. An inopportune shower at the end of March formed a crust over the seed holes, so that it was necessary to give a quick irrigation to encourage germination. Another heavy shower fell in April. The growth of the crop in May

was not very rapid and a certain amount of leaf-withering was noticed at this time. An abnormal feature of May was the occurrence of five showers, amounting to over an inch of rain, in a month which is usually dry. Flowering and boll-setting in June and July were normal, but in August there was a good deal of shedding. Strong winds and dust-storms were rather prevalent this season. Bollworm attack began in June, and this pest had multiplied considerably by the end of July. The second flush of flowers was rather short and the later bolls were found to be opening immaturely at the beginning of October. On the whole the season was not very favourable.

Insect Pests.

(*a*) *Thrips.*—A kind of leaf-curl, known locally as "lufluf," is sometimes noticed early in the season at the beginning of May. This disease, which is due to thrips, checks the growth of the crop by making the young buds curl and wither before they are properly open. It is not generally serious. As the season advances the plants grow more vigorously and soon outstrip the attack. The disease especially retards the growth of plants which are situated on poor land or are growing under bad conditions, but it does not seem to interfere much with the development of a normal healthy crop. There was a certain amount of thrips attack on cotton in 1929, but very little in either of the other two seasons.

(*b*) *Spotted bollworm* (*Earias insulana*).—This is the most serious pest of American cotton in Iraq and causes considerable damage to the crop each year. It is possible that this insect was originally present in the country feeding on local Iraqi cotton (*G. herbaceum*) and other malvaceous plants such as "bamia" or ladies' fingers (*Hibiscus esculentus*), hollyhock (*Althaea rosea*) and Deccan hemp (*Hibiscus cannabinus*), and that it only became recognised as a major pest on the introduction and extension of the cultivation of American cotton after the war. Local cotton, which has probably been grown in Iraq from time immemorial, though attacked by bollworm, appears to be much less susceptible than Mesowhite and other varieties of American cotton.

The life cycle of the spotted bollworm has been studied by Mr. A. Dutt, formerly Entomologist at Rustam, who found that in Iraq the larvae do not pass the winter in cracks in the ground, as they are reported to do at Surat (Bombay Presidency), but that a few probably remain sheltered in fallen bolls and thus manage to survive during the cold season. The fact that after a cold winter the incidence of bollworm is usually less than after a mild one supports this supposition. In January, 1925, Mr. Dutt examined nearly 700

attacked buds and bolls which had fallen from cotton during the preceding season. He found about 400 dead larvae and only one alive. Most of the larvae are probably killed by cold and shortage of food, but a few survivors emerge in February and manage to subsist on " bamia " and other plants until the cotton crop is sown. Although the number of bollworm at the beginning of the season is often very low indeed, as soon as the conditions get easier and food material becomes plentiful, the population begins to increase very rapidly and continues to do so throughout the season, the only checks to multiplication being the dry heat of mid-summer and the natural increase of the parasites which prey on *Earias insulana*, one of which has been identified as *Microbracon kitcheneri*. Infestation reaches its maximum during the cool weather of autumn before the crop is cut out and it is then not uncommon to find as many as half the bolls on the cotton plants damaged by bollworm.

Bollworm first damages the crop in the early part of the season by feeding on the top shoots and thereby checking the natural development of the plants. Later it feeds entirely on the young flower buds and bolls, many of which fall off. Finally, mature bolls are attacked. The insect enters by eating a small hole in the boll-wall and causes damage directly by feeding on seeds and unripe cotton hairs and indirectly by the introduction of fungi and bacteria into the interior of the boll. A sooty black fungus (*Rhizopus nigricans*) is commonly introduced by bollworm. The abundance of these blackened bolls is a feature of the crop towards the end of the season. The normal practice for control of the spotted bollworm is hand collection and destruction of damaged shoots and buds containing larvae in the early part of the season. At the end of the season the crop is cut out, all cotton sticks and other debris are burnt and the land is ploughed up. Ratoon cotton has been shown to be a source of infestation in Iraq, and a recent ordinance has strengthened the law against the growing of ratoon cotton. Unfortunately the administrative authorities have not enforced this law in the past, but it is hoped that they will now be able to do so.

In 1929 bollworm attack was particularly severe and the second flush of cotton was almost entirely destroyed. As the usual method of control did not appear to have had sufficient effect, it was decided to carry out an experiment with sodium fluosilicate dust in the following season, this method having been reported to have given good results in Egypt. The succeeding winter was mild and an early infestation was expected, nevertheless bollworm attack did not become serious until very late in the season, thus detracting from the value of the

experiment. Random counts of the bollworm population were taken at intervals during the season and it was not until the middle of September that the percentage of infested buds and bolls approached 5% of the total number. Accordingly, the first dusting with sodium fluosilicate was not given until September 20th. The experiment was divided into twelve plots, six plots being dusted and six left undusted as a control. After dusting, weekly counts of the bollworm population were maintained, twenty plants being chosen at random in each plot every time a count was made. A second dusting was given on November 10th, when the percentage of infestation in the control plots was approaching 10%. In mixing the insecticide equal parts of sodium fluosilicate powder and flour were used, the flour being merely a carrier to give extra body to the insecticide ; flour also helps the mixture to stick to the plants. A hand-gun duster was used which had a range of about six feet and covered the plants very well. About 8 lbs. of the mixture were found to be sufficient to dust an acre of cotton. The general effect of dusting on the bollworm population in 1930 and 1931 respectively, is shown graphically in Figs. 4 and 5. Both experiments show clearly that dusting lessens the incidence of bollworm, but the effect is not so great as would be expected.

At the same time a preliminary trial was carried out on a larger area of cotton with a Shunk motor duster, drawn by a tractor. The effective range of the machine, of course, varies with the wind and other conditions prevailing, but under normal conditions it was found to cover a belt of cotton about seventy yards wide on each journey up the field. Its chief advantage is that it is able to cover a large area in a short time. It was found to be very extravagant, however, as it used nearly ten times as much mixture as the hand-gun. The motor duster will be tried again next season, but it is feared that the cost of the operation may be too high to be economic.

(*c*) *White fly.*—An Aleurodid believed to be similar to the species which attacks cotton in the Punjab and in the Sudan, is often present in cotton fields in Iraq. This insect is not usually regarded here as a serious pest and its effect depends much on the season. In 1929, when weather conditions were favourable to its multiplication, it did considerable damage to cotton. In 1930 and 1931 white fly appeared late in the season and never showed signs of becoming serious. Even in 1929 the damage done to the cotton crop at Rustam did not appear to be very great, but in the country districts, where cotton is generally unthinned and over-irrigated, there is no doubt that this pest causes considerable loss to cotton growers. The castor-oil plant, which is used as a wind-break, sometimes grows too luxuriantly under the

FIG. 4 - SODIUM FLUOSILICATE DUSTING EXPERIMENT - 1930

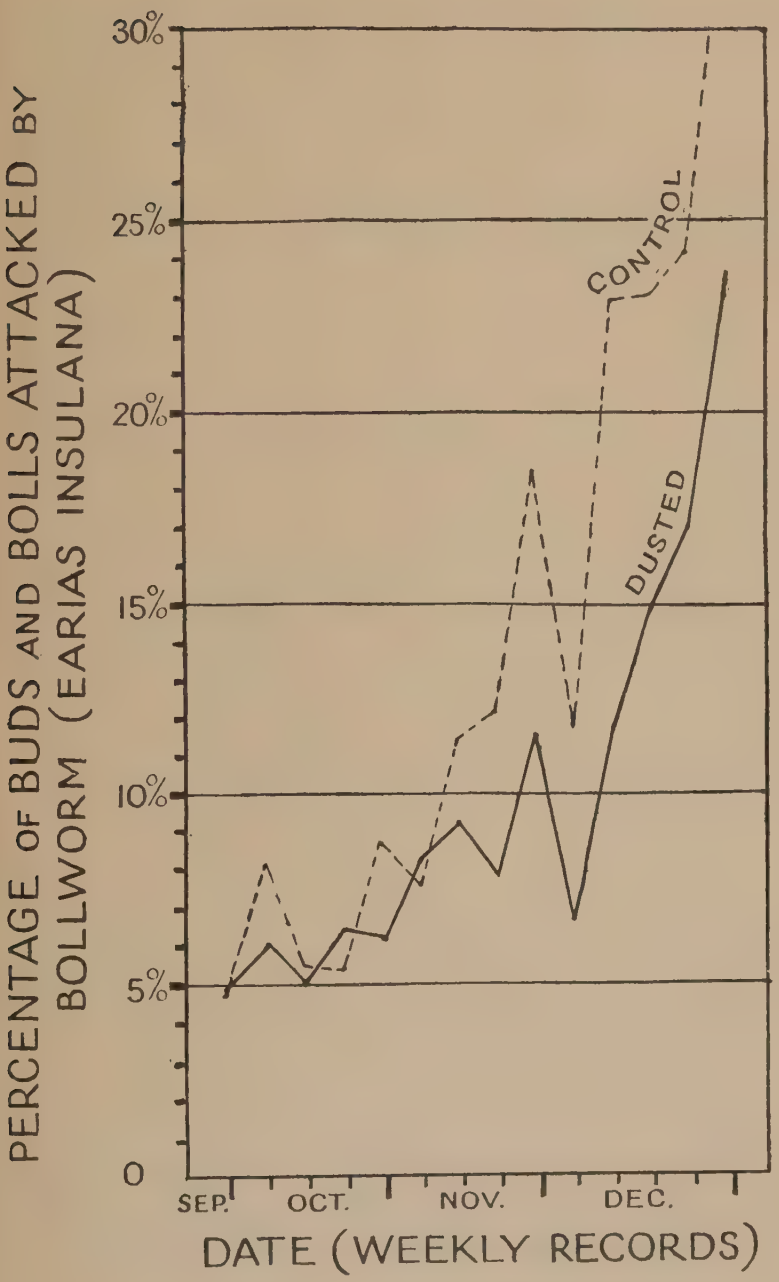
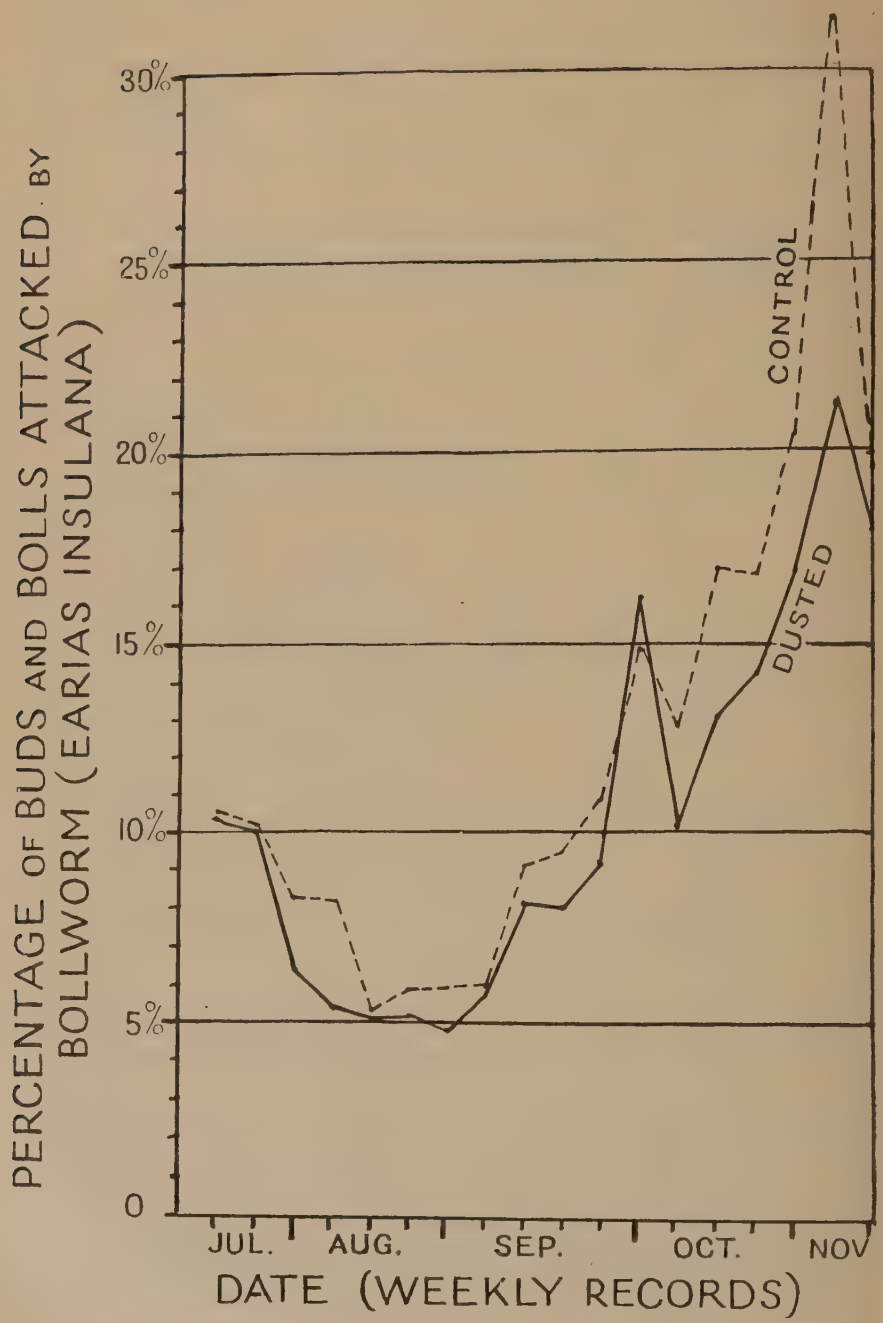


FIG. 5 – SODIUM FLUOSILICATE DUSTING EXPERIMENT – 1931



excessive watering given by farmers, so that it hems in and shades the plants, encouraging the multiplication of white fly. The disease is known locally as " man," a name also applied to Aphis, and is derived from the sticky secretion of " manna " or honey-dew found on the leaves of plants attacked by these insects. In damp situations where the plants are not properly aerated the honey-dew encourages the growth of fungi on the leaves and bolls, and the lint may also be damaged. White fly causes premature opening of the bolls, the lint of which is often weak and lacking in lustre. The insects cause shedding and probably weaken the plants by their punctures, so that the cotton becomes more susceptible to adverse changes of climate or to poor cultivation. Calm, windless days and relatively high humidity favour the multiplication of white fly in the cotton fields and the pest can then best be checked by cutting down the water supply of the crop.

(*d*) *Locusts.*—The annual depredations of the Moroccan locust (*Dociostaurus marocanus*) are chiefly responsible for preventing the extension of cotton-growing in the sub-montane area round Mosul and elsewhere in northern Iraq. This species, which is endemic in the north, fortunately does not extend south as far as the provinces of Baghdad, Kut and Hillah, where most of the Mesowhite cotton is grown. In this southern area visitations of the Nejdi locust (*Schistocerca peregrina*) occur periodically, and it is undoubtedly fear of this insect which has done much to cause the falling-off in the production of Mesowhite cotton in Iraq during the last few years. In 1928 production reached its maximum ; in 1929 over twice as much seed was issued as in the previous year, but the number of bales produced was smaller, Nejdi locusts being chiefly responsible. Besides the actual damage to growing cotton and the reduction in area caused by fear of locust attack, many farmers failed to thin their cotton under the mistaken belief that this would afford them some protection against the total destruction of their crop, while others delayed sowing until much too late in the season when they considered that the danger of locusts had passed. In the following year (1930) fear of Nejdi locusts was reflected in the diminished demand for seed, and the production of cotton fell off still further. In both these years the locusts visited Rustam on one or two occasions, but no difficulty was experienced in driving them off. Lines of fires were lighted as smoke screens along the windward side of the cotton fields and gangs of people were sent through the crop to scare away locusts which had settled.

Past experience has shown that the Nejdi locust is not endemic in Iraq and cannot as a rule withstand the rigours of the climate. It is

only under the most favourable circumstances that swarms from other parts of the world manage to reach Iraq and survive for one or two seasons. This was again proved in 1931, for in spite of the numbers which had been prevalent in the two previous seasons, hardly any locusts emerged and no damage was done to crops.

(*e*) *Greasy cutworm* (*Agrotis ypsilon*) is generally found attacking and destroying a considerable number of young cotton seedlings about the middle of April. It can be controlled quite easily by hand collection and destruction of the larvae at this stage.

Seed Propagation and Distribution.

The distribution of seed, selected and controlled by the Department of Agriculture, is effected through the British Cotton Growing Association, who up till 1930 ran the only ginnery in Iraq. The recent extension of this ginnery and the erection of a rival ginnery at Baghdad in 1930 have not justified themselves, as the crop has unfortunately decreased. Since 1920 the seed issued to farmers has practically been confined to strains of Mesowhite cotton. In 1931 the bulk of the seed was of the strain R 82 which has replaced the older strains R 53, R 68 and R 90. During the last year or two these strains had been showing signs of deterioration. A cross-bred strain, R 124, was also issued in 1931 for propagation on a single estate. No other varieties were issued to this estate, which is isolated, and every precaution was taken to ensure that the seed should be propagated without contamination. Owing to successive curtailments of the budget the propagation area at Rustam has been reduced to about a fifth of its former size and it is now necessary to make some such arrangement for the multiplication of new strains. The following table shows the acreage under cotton and the yield per acre obtained on the Rustam propagation areas for the last three years. The mean yield works out at 750 lbs. of seed-cotton per acre, which is

TABLE III.

Acreage and Yield of Cotton at Rustam (Propagation Areas), 1929–1931.

Year.	*Acreage.*	*Yield in lbs. per acre (seed-cotton).*
1929	148	970
1930	88	590
1931	30	700

almost exactly the same as the mean yield on the farm for the previous five years (1924–1928). Unfortunately it is impossible to get accurate statistics showing the yield per acre obtained by farmers in Iraq.

Seeing that the land at Rustam is not very good and the summer irrigation water is saline, there seems no reason why the ordinary farmer, if he pays attention to the cultivation of his crop, should not at least equal if not exceed the above yield. The total quantity of seed issued by the British Cotton Growing Association with the total production of bales of cotton in Iraq for the last four years is given below. How much of the seed issued was planted is not known, but

TABLE IV.

Seed Issued and Production of Cotton in Iraq (1928–1931).

Year.	*Tons of seed issued by the British Cotton Growing Association.*	*Total production of bales of cotton in Iraq (bales of 400 lbs. each).*	*Bales produced per ton of seed issued.*
1928	114	5,200	46
1929	230	4,700	20
1930	171	3,300	19
1931	71	1,000*	14*

*Estimate.

it is certain that in 1929 and 1930 a large proportion was never sown through fear of locusts and other causes. In 1931 locusts were expected, but did not materialise, and the falling-off in production is chiefly attributed to the slump in the price of cotton. The area under cotton was generally curtailed and towards the middle of the season, when prices reached a very low ebb and showed no signs of recovering, many farmers ceased irrigating, turned in their sheep and abandoned the crop altogether.

Variety Trials.

The programme followed in 1929 had been laid down by the late Cotton Breeder before he left Rustam. In the main varietal test several cross-bred strains and strains of Mesowhite were compared. None of the strains tested showed any marked superiority and there seemed to be very little agricultural difference between them. Much the same result had been obtained in 1928, and, as there seemed to be little object in retaining so many similar strains, it was decided to choose one as a standard and discard the rest. The best Mesowhite strain, R 82, was accordingly chosen. Of the remainder only one, R 124, stood out by reason of its high ginning percentage. R 124 was derived from a cross between Mesowhite and Punjab 285 F; it had promised well as a good yielder in preliminary trials in the previous year and the quality of the lint compared satisfactorily with the others. The quantity of seed of R 124 available was small and it was decided to propagate it while further trials were taking place.

When varietal trials were first carried out a number of different types of cotton were tried. Some of these types proved to be unsuitable ; for example, Ashmouni and Sakellarides in spite of their excellent vegetative growth and promising appearance did not mature their bolls properly and gave an unsatisfactory yield. The Department is sometimes pressed to repeat trials with Egyptian cottons, but former experience has shown conclusively that they will not stand up to the climate of Baghdad. They grow extremely well in the early part of the season, but cease growth completely during the hot dry weather of July and August. When they revive and begin to grow again in September it is too late, for the cold weather is approaching. In the early trials carried out by the Department a few cottons showed signs of being as good if not better yielders than Mesowhite, but were rejected on account of their shorter staple. Middling American was then at a high price and the premium on Mesowhite was sufficient to counterbalance even a considerably higher yield of any of these shorter staple cottons. During the last year or two conditions have changed and it seems possible that one of these short-staple high-yielding cottons may become more profitable to the grower than Mesowhite ; hitherto it has always been considered advisable to continue with the longer-stapled variety. In 1930 Acala, Cawnpore, Durango and a Punjab×Mesowhite cross were given a further trial in comparison with Mesowhite. The results are given below. The standard error

TABLE V.

COTTON MAIN VARIETAL TEST (1930).

Rustam No.	*Name or origin of variety.*	*Mean yield of seed-cotton per ⅕₀ acre plot (in lbs.).*	*Standard deviation.*	*Standard error.*	*Difference between mean yield of R 82 and others.*	*Standard error of the difference.*
R 53	Mesowhite (Webber 49-3) ...	63·3	10·3	3·6	+ 1·8	7·2
R 82	Mesowhite (Webber 49-3) ...	61·5	17·5	6·2	—	—
R 114	Cawnpore	68·3	15·3	5·4	+ 6·8	8·2
R 124	Mesowhite×Punjab 285F ...	70·7	10·8	3·9	+ 9·2	7·3
R 130	Durango	67·7	15·7	5·5	+ 6·2	8·3
R 133	Acala	82·0	16·0	5·7	+20·5	8·4
R 138	Acala	85·4	13·4	4·7	+23·9	7·8

in this experiment is high, but Acala has given a significantly higher yield than the standard (R 82). The ginning percentage of R 82 was 28% and of Acala 33%. The cross-bred variety, R 124, again did well in the trial and gave a ginning percentage of 31% ; the lint of this variety is similar to Mesowhite and its yielding capacity appears to be as good. The lint of Acala (R 138) is coarser and shorter, but the actual increase in yield is very great. R 53, an old strain of

Mesowhite which has recently shown signs of deterioration, and R 133, which has an even shorter staple than R 138, were discarded, R 114 and R 130 being retained for further trial.

The superior yielding capacity of Acala (R 138) was confirmed by the varietal test of 1931, the results of which are given below. The differences in yield between the other varieties and the standard were not significant. R 124 has again given a rather better ginning

TABLE VI.

Cotton Main Varietal Test (1931).

Rustam No.	*Mean yield of seed-cotton per ⅕ acre plot (in lbs.).*	*Standard deviation.*	*Standard error.*	*Difference between mean yield of R 82 and the others.*	*Standard error of difference.*	*Ginning %.*	*Lint length in mm. (halo).*	*Weight per 100 seeds in grams.*	*Lint index.*
R 82 ...	39·3	5·9	2·4	—	—	28·3%	30·6	10·7	4·2
R 114...	34·5	16·1	6·6	− 4·8	7·0	28·5%	29·9	11·5	4·6
R 124...	41·9	7·5	3·1	+ 2·6	3·9	29·7%	29·4	11·4	4·8
R 130...	38·0	13·4	5·5	− 1·3	6·0	31·3%	27·8	11·1	5·1
R 138...	55·2	14·0	5·7	+ 15·9	6·2	33·0%	26·8	13·4	6·2
R 140...	33·1	13·1	5·4	− 6·2	5·9	28·4%	30·9	11·0	4·4

percentage than R 82. This variety is not yet entirely free from rogues, but material from pure selections is being propagated.

Each of the above varietal trials was laid out in six sub-groups of plots, each sub-group containing one plot of every variety under trial. The plots in each sub-group were arranged at random.

Breeding and Selection Work.

When Mesowhite was chosen for cultivation in Iraq it was soon found to give a very low ginning percentage in this country. According to the breeders of Webber 49-3, from which Mesowhite was derived, the out-turn of lint should be from 31 to 33·3%. No results approaching this have been obtained in Iraq where the ginning percentage of even the best selections of Mesowhite does not exceed 27-30%. Commercial ginning percentages as low as 23% have been recorded, while 24–26% is not uncommon. One of the chief objects of the cotton-breeding work at Rustam has been to improve the lint out-turn of Mesowhite cotton. With this object Mesowhite was crossed some years ago with Punjab 285 F and other varieties which give a comparatively high ginning out-turn. Up to the present R 124 is the only strain obtained from this material which shows any decided improvement. At the same time new selections were made from Mesowhite so as to prevent deterioration.

These pure line selections and cross-bred strains were left by Mr. Sawhney in 1929, but it soon became apparent that there was too much material to be handled with the reduced staff available. The number of single-plant progenies was greatly reduced and the progeny of several crosses which showed no promise was discarded completely. Out of 150 plants selected in the field by the Cotton Breeder in 1930 seventeen were finally chosen for trial in single-plant progeny rows last season. It has not yet been possible to complete the examination of these progenies or of the further selections made in the field. The material at present available consists chiefly of strains of Mesowhite, derived from plants which showed desirable characters, a few selections from Acala plants showing a fair quality of lint, and some selections from the cross-bred variety R 124 which was found to be not entirely pure. In 1930 a cross was made between Acala and Mesowhite and the F.1 grown out last season.

Field Experiments.

(*a*) *Date-of-Sowing Test.*—This experiment which had been initiated in 1926 was concluded in 1929. The results show conclusively that the best time for sowing cotton lies between the middle of March and the middle of April. This agrees with previous records. If the sowing of cotton is delayed beyond the end of April the yield is apt to fall off considerably. It is not safe to sow before the middle of March owing to the danger of late frosts, but from then onwards the daily temperatures are almost always sufficiently high to ensure a successful germination, though they are too low for the plants to make much growth. When the temperature rises in May the plants start growing vigorously. Flowering starts in June and continues until the beginning of July when it begins to slow down. At the hottest part of July and August hot dry winds have an adverse effect on the crop, checking flowering and possibly causing much shedding. It is probably for this

TABLE VII.

Date of Sowing Test (1929).

Date of sowing.	*Mean yield of seed-cotton per $\frac{1}{10}$ acre plot (in lbs.).*	*Standard deviation.*	*Standard error.*	*Difference between mean yields and yield for 30th March.*	*Standard error of the difference.*
16 March ...	43·8	10·4	3·3	— 6·4	5·6
30 March ...	50·2	14·3	4·5	—	—
15 April ...	42·7	14·5	4·6	— 7·5	6·4
30 April ...	34·7	11·2	3·5	—15·5	5·7
15 May ...	26·5	10·8	4·8	—23·7	6·6
30 May ...	13·9	1·9	0·8	—36·3	4·6

reason that late-sown cotton does not succeed better. Cotton sown in May does not flower until July and the hot weather checks it before the natural peak of flowering has been reached. When favourable conditions return towards the end of August or the beginning of September it is too late for this check to be regained.

(*b*) *Cultivation Test.*—This experiment was started in 1928, partly to demonstrate the ill-effect of allowing weeds to grow unchecked among cotton and partly to compare different methods of cultivation. Although a few of the better farmers make some attempt to keep their crop clean, the land on most estates where cotton or other summer crops are grown soon becomes foul and over-run with grasses and other plants. The results of the experiment have been unexpected and somewhat conflicting. The plots were laid out each year on the system of controlled randomisation, but the standard errors are so high

TABLE VIII.

Cotton Cultivation Test (1928–30).

Treatment.	*Mean yield of seed cotton per $\frac{1}{20}$ acre plot (in lbs.).*		
	1928.	1929.	1930.
Control—untouched (neither weeded nor cultivated)	27·3	31·7	—
Hand-weeding only—control 1930	42·7	41·4	63·0
Horse-hoeing	32·1	32·9	65·1
Fassing (hand-hoeing)	36·3	35·7	70·2
Horse-hoeing and fassing	—	—	69·5

that there is no object in giving them here; the differences in yield between the series cannot be regarded as significant. It is nevertheless curious that the series which was weeded without any cultivation should have given the highest yield in two successive years. The soil at Rustam is tricky and in the summer it bakes and cracks badly after irrigation, so that it is extremely difficult to hit off exactly the right time for interculture. In the morning the land may be too wet to work, but by mid-day it may have dried in the sun and baked into lumps several inches across. Stirring the soil at this stage may tear up and break the delicate rootlets of the cotton plants thus giving a marked set-back to the crop. Thus it was considered that the conditions under which the experiment had been originally laid down had been too rigid and that greater latitude should have been allowed to the fieldman to use his discretion. This may account for the lower yield of the series of plots which were cultivated with the horse-hoe. Fassing has a similar effect, though not so harmful; it breaks the surface crust on the sides of the ridges and helps to build up the latter where they are broken, but is an expensive operation.

In 1930 greater care was exercised in choosing exactly the right time for interculture and the results are more in accordance with expectation. Attempts are also being made to devise an implement which will scoop out the bottom of the troughs, build up the ridges broken down by irrigation, pulverize the lumps and gently break the crust on the ridge sides with the minimum of disturbance of the surface roots, since the roots of an irrigated crop are inclined to develop more on the surface than at deeper levels. A small disc-cultivator was built for this purpose. The central pair of discs is set close together with each disc facing outwards so as to scoop out the bottom of the trough, while smaller discs are mounted on either side and arranged so as to rest on the side of the ridges. This implement was tried in 1931 and appeared to work satisfactorily, but unfortunately the experimental error is again so high that the results are of doubtful value. The series cultivated with the horse-hoe gave about 20% better yield than the uncultivated, but hand-weeded, control, while the series cultivated with the disc-cultivator gave yields that exceed it by 50%. The disc-cultivator should certainly prove a more satisfactory implement than the horse-hoe since it pulverizes the soil and helps to build up the broken ridges while the horse-hoe merely stirs the bottom of the troughs and tends to break the ridges down still further.

(*c*) *Thinning and spacing experiments* were carried out from 1922–1924 by Mr. Sawhney, but as the results of these experiments have not hitherto been published it seems worth while to mention them briefly here. The following information has been taken from Mr. Sawhney's reports. Various spacings were tried ranging from 30 inches × 6 inches to 60 inches × 48 inches, and the highest yield was obtained in two consecutive years from the spacing 30 inches × 18 inches. With the exception of the extreme spacings, all the others gave much the same yield, showing that under good cultivation there is a large range which will give good results. The spacing adopted by the Department in both its experimental and propagation cotton fields was 36 inches × 15 inches, which allows the same area of soil surface per hill as 30 inches × 18 inches. The wider spacing of the ridges is found to be more convenient for interculture.

The thinning experiments which were carried out in 1924 showed that the best results are obtained by thinning to two plants per hill about the beginning of May when the flower buds are just forming. Thinning to 1, 3 or 4 plants per hill or leaving the crop unthinned gave lower yields, though there was not very much difference between them. Delayed thinning reduced the yield more seriously and caused the plants to grow in a spindly shape. The local farmer is generally

late in thinning and often leaves his crop unthinned. Combined with over-watering this greatly encourages the multiplication of bollworm and other pests.

(*d*) *Manurial Test.*—This experiment was carried out by Mr. Sawhney from 1926–1928 but gave inconclusive results. In 1929 it was laid out with the plots in a controlled random arrangement, but the probable errors were so high that the results are not considered reliable. Sulphate of ammonia, superphosphate and green manure all gave higher yields than the control. Unfortunately the experiment had to be abandoned in 1930 owing to lack of funds. The question of green manure for cotton is important. At present berseem is the best crop which has been found for this purpose. It is extremely unlikely that the local farmer can be induced to spend any money on chemical fertilizers for a field crop.

Rotation Crops.

Crops grown in Iraq can be fairly sharply divided into winter crops and summer crops. The principal winter crops all over the country are barley and wheat; these crops are grown on irrigation in the southern and central areas and on rain in the sub-montane area of the north. A local "vetch" called Hurtuman (*Lathyrus sativus*) is grown to some extent with winter cereals, and lucerne is cultivated in the neighbourhood of towns such as Baghdad and Basrah, where it has a ready sale for fodder. Lentils, broad beans, etc., are grown in small areas, and the Department of Agriculture has lately introduced the cultivation of linseed which is rapidly becoming popular with some of the more enlightened cultivators. Summer crops are more limited in extent, the water supply being the limiting factor. The most popular crop where ample water is available is rice; large areas are grown in the marshes of southern Iraq and in other parts where there is an abundant flow in summer. Other summer crops grown in different parts of the country are sorghum, local dwarf maize, cowpeas, green gram (*Phaseolus*), sesame and cotton. Castor-oil, sunflower and Deccan hemp are also grown at Rustam.

Winter crops are sown from October to December (or often later by the desultory cultivator) and harvested in May. Summer crops are sown from March to May or June and harvested from August to November. It will thus be seen that there is a considerable overlap between the two seasons and that there is the greatest pressure of work on the farm in the spring and autumn when the sowing period of one lot of crops coincides with the harvesting of the other. The finding of suitable rotation crops for cotton is not easy. The normal rotation

is winter cereal, bare fallow, cotton or other summer crop, bare fallow, winter cereal, the cycle occupying a period of three years from the sowing of one winter cereal crop to the sowing of the next. The first fallow lasts for almost a year and the second for about nine months. The question naturally arises whether green crops cannot be grown during either of these periods, though without a periodic bare fallow the texture of the soil would suffer seriously under continuous irrigation. The soil in Iraq is notably deficient in nitrogen and it is thus most important that fertility should be kept up by growing nitrogenous green manures. There is unfortunately no winter green manure which is entirely satisfactory. Hurtuman, the local "vetch," does well, but it does not produce its best growth until late in the season, at the time when cotton is being sown. The best crop which has been found is berseem (*Trifolium alexandrinum*) which can be sown in October and produces a good stand of herbage by February. This can either be ploughed in or folded by sheep, but whichever method is adopted leaves hardly time to prepare the land for cotton, unless the berseem is removed before it has made the best growth of which it is capable, nor is there time for the green manure to rot down before the cotton is sown. Another crop which can be sown early in the autumn and folded by sheep is rape, but this plant, besides being non-leguminous, is not very easy to grow owing to the difficulty of obtaining an even germination on an irrigated seed bed. Of the summer green manure crops cowpeas are perhaps the most suitable. In summer the rivers are low, pumping costs are high and water may not be very abundant.

This, combined with the necessity of giving the land a bare fallow, makes it doubtful whether the growing of summer green manure crops can be recommended.

A brief mention of the work on crops other than cotton at Rustam may be of interest.

Winter cereals.—Wheat No. 210 (Punjab 8A) has surpassed all others tried on the farm. It is well liked on the local market and fetches a good price for export. This variety has been propagated at Rustam during the past few years and issued in considerable quantities under the name of *Ajibah*. Many of the large farmers in Iraq are now growing it. Owing to the shortness of the ripening season and the quick onset of summer, attempts to grow malting barleys have not been successful, but two good feeding barleys, Californian (No. B 150) and Moroccan (No. B 128) have proved superior to any local type and have been issued from the farm. Oats are not grown as a field crop in Iraq; imported varieties tried at Rustam yield well, but produce thin grain with a large proportion of husk.

There is a local prejudice against oats, which are much despised since the wild oat occurs as a troublesome weed in cereal crops and gets mixed with the grain, but with the issue of superior varieties the farmer is becoming aware of the importance of keeping his produce pure and clean.

Linseed.—Experiments at Rustam have shown Moroccan and River Plate linseed to be suitable for cultivation in Iraq owing to their immunity to rust disease (*Melampsora lini*) which invariably attacks the Indian varieties grown on the farm. The Department imported 100 tons of seed in 1930 and distributed it to farmers with instructions for its cultivation. Most farmers were pleased with this new crop and its area will probably be much extended this winter. The average yield at Rustam during the past few years is about 800 lbs. per acre as compared with 1,000 lbs. per acre for wheat and 1,250 lbs. per acre for barley.

Horse beans (*Vicia faba*).—An American variety of small-seeded horse-beans was introduced from California, and has done well at Rustam. Horse-beans are grown in Iraq, often as a mixed crop with barley, but the new variety is superior to the local varieties and commands a good price for export. Seed is now being propagated at Rustam for issue to the farmers.

Maize.—The local maize is a dwarf variety grown as a summer crop in many parts of the country. A good many imported varieties have been tried at Rustam. Of these only one, Lalton, originally obtained from India, has been really successful. This variety was propagated on about 15 acres of land last summer. The exact yield is not yet determined, but it promises to be good. Although Dent maize from the United States of America grows well it does not have time to ripen properly before the winter. If planted early, the weather is too hot and dry at the time of flowering and a large proportion of the cobs are half-empty. Dent maize suffers severely from the attacks of stem-borer (*Sesamia cretica*). Lalton maize which is being propagated by the Department does not suffer to the same extent.

Deccan hemp (*Hibiscus cannabinus*).—This crop grows extremely well and an Indian red-stemmed variety has proved most suitable for cultivation. The Arabs often grow a short local variety as a border round fields of summer cultivation, and make rough ropes out of the fibre. There is no doubt that Deccan hemp can be grown here successfully, but the difficulty and cost of retting and preparing the fibre must be considered before the crop can be introduced on a large scale. This matter is being investigated. One of the disadvantages of Deccan hemp is that it harbours bollworm and other pests of cotton.

Castor-oil is often grown as a wind-break for cotton. It grows well and produces a fair yield, but it is a costly crop to pick owing to its habit of shattering if the ripe capsules are left on the plants too long ; it thus requires constant picking over a long period. Attempts are being made to find a variety which ripens the bulk of its produce at one time. Castor-oil is a valuable product and would find a ready local sale as a lubricant for irrigation engines and other machinery.

Sunflower.—This crop has proved rather disappointing in spite of its former promise. The plants grow extremely well but are always very badly damaged by sparrows at the time of ripening. It seems difficult to control these pests which always reduce the yield very seriously. Sunflower is not grown by the local farmer.

Sesame is a common summer crop in the districts and appears to be profitable, though the local varieties are very mixed and do not command the best price on the market. Attempts to improve the seed by isolating a pure white-seeded type have failed since the crop at Rustam is always badly attacked by wilt disease (*Rhizoctonia bataticola*). This condition is believed to be brought on and encouraged by the high salinity of the summer irrigation water to which sesame appears to be peculiarly susceptible. Neighbouring estates watered with the fresh water of the Tigris are little affected by the disease.

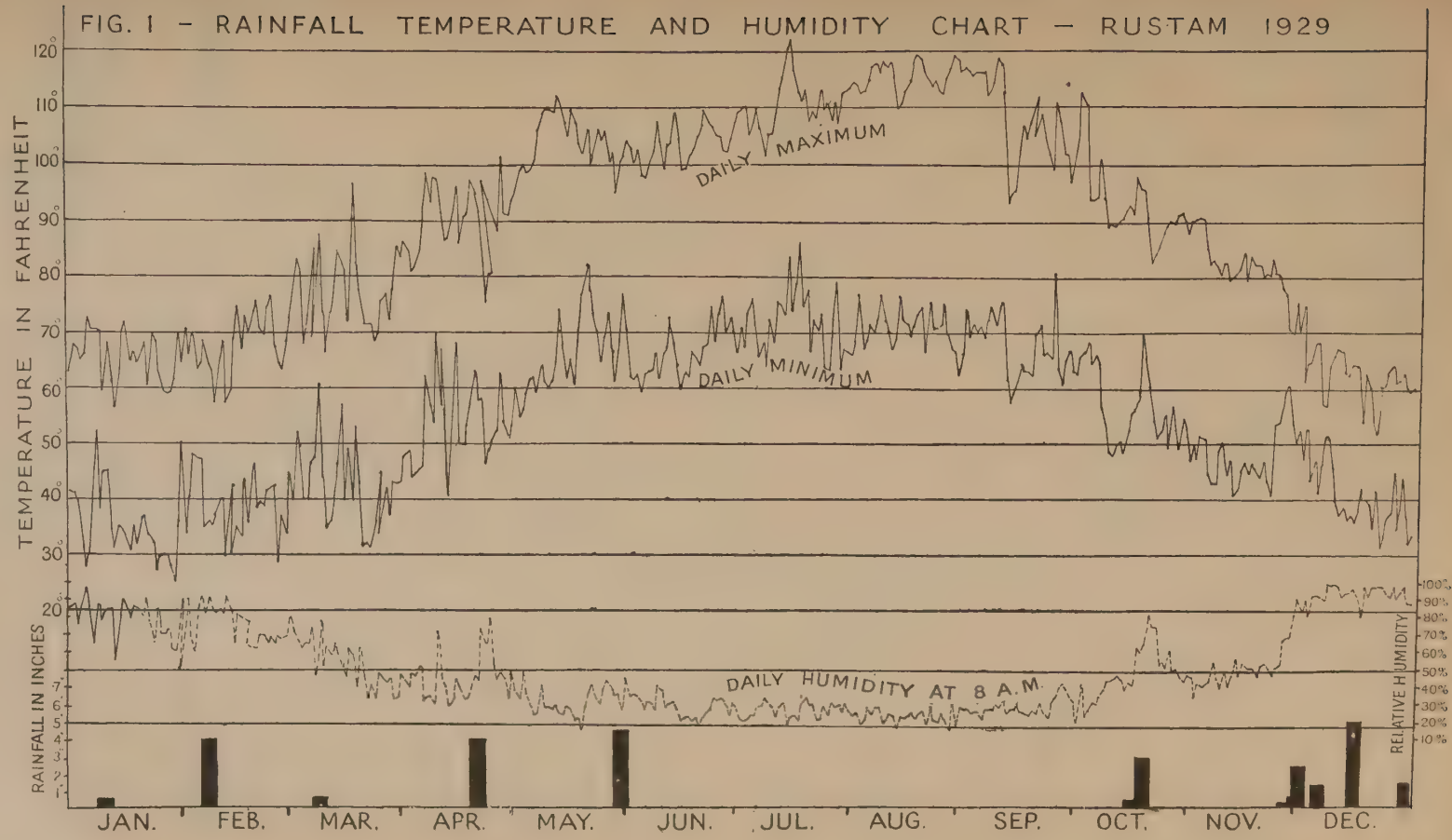


FIG. 1 – RAINFALL TEMPERATURE AND HUMIDITY CHART – RUSTAM 1929
TEMPERATURE IN FAHRENHEIT
120°
110°
100°
90°
80°
70°
60°
50°
40°
30°
DAILY MAXIMUM
DAILY MINIMUM
DAILY HUMIDITY AT 8 A.M.
RAINFALL IN INCHES
RELATIVE HUMIDITY
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
JAN.
FEB.
MAR.
APR.
MAY.
JUN.
JUL.
AUG.
SEP.
OCT.
NOV.
DEC.

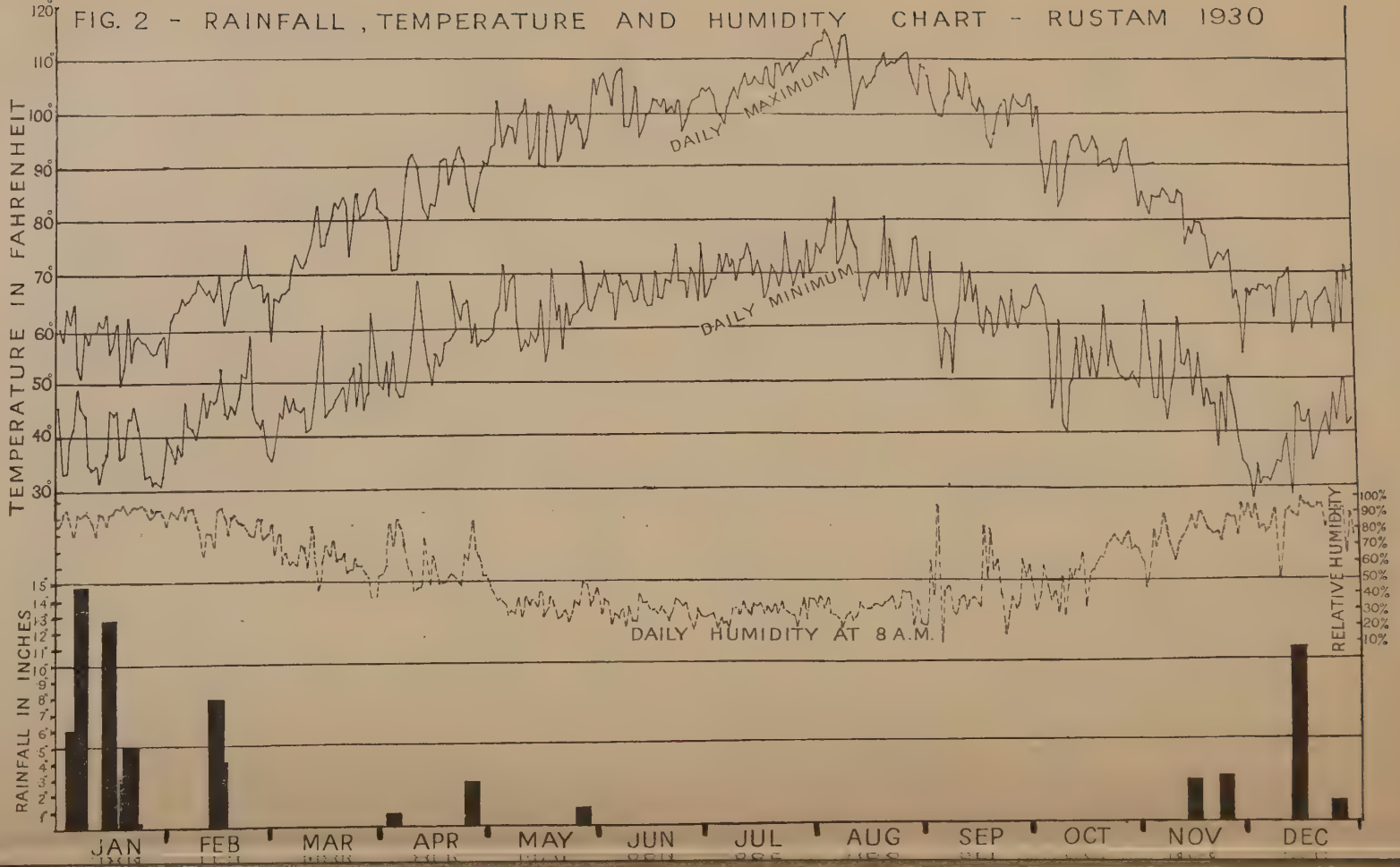


FIG. 2 - RAINFALL , TEMPERATURE AND HUMIDITY CHART - RUSTAM 1930
TEMPERATURE IN FAHRENHEIT
120°
110°
100°
90°
80°
70°
60°
50°
40°
30°
DAILY MAXIMUM
DAILY MINIMUM
DAILY HUMIDITY AT 8 A.M.
RELATIVE HUMIDITY
100%
90%
80%
70%
60%
50%
40%
30%
20%
10%
RAINFALL IN INCHES
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

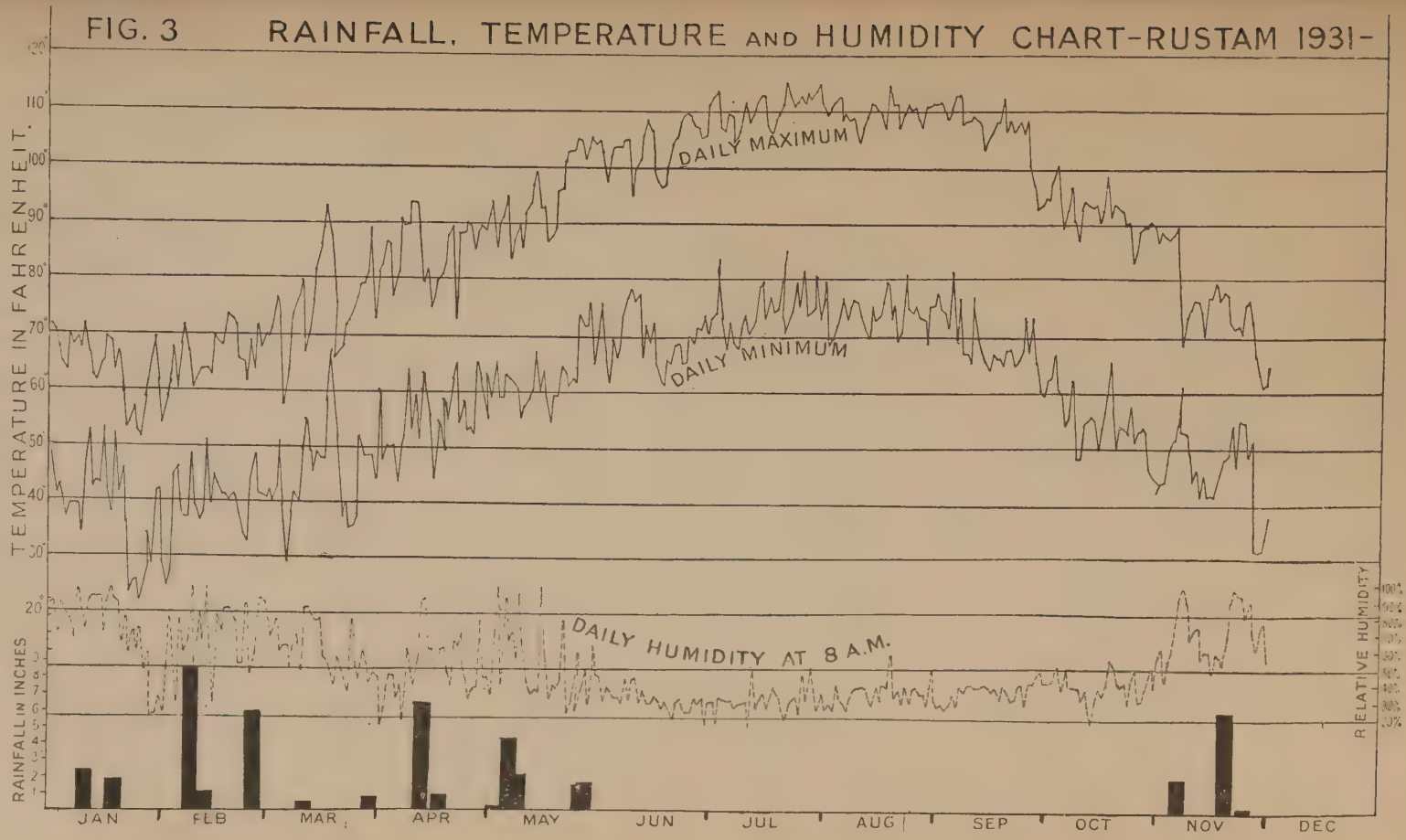


FIG. 3 RAINFALL, TEMPERATURE AND HUMIDITY CHART-RUSTAM 1931-
TEMPERATURE IN FAHRENHEIT.
120°
110°
100°
90°
80°
70°
60°
50°
40°
30°
20°
DAILY MAXIMUM
DAILY MINIMUM
DAILY HUMIDITY AT 8 A.M.
RAINFALL IN INCHES
RELATIVE HUMIDITY
JAN
FEB
MAR
APR
MAY
JUN
JUL
AUG
SEP
OCT
NOV
DEC

WEST INDIES.

REPORT OF THE COTTON EXPERIMENT STATION, ST. VINCENT, FOR THE SEASON 1930-31.

Summary of Results

BY

S. C. HARLAND AND S. H. EVELYN.

General.

The successful effect of changing the planting season from June to September was again demonstrated in the 1930-31 cotton season, record yields being obtained at many of the estates, while at the Station an estimated figure of about 500 pounds of lint per acre was obtained from the pure V. 135 (Superfine) plot.

The weather conditions at the end of the season could not have been better, with the result that the cotton harvested was dry, bright and clean with a higher ginning percentage than has been obtained in former years.

Pests came in too late to cause any appreciable damage; nevertheless it was considered that a longer close season would be beneficial, and so, instead of the former two months, the close season extended from May 1st to August 31st. At the Station only the perennial cottons, which were planted late (October 3rd), suffered to any extent from pests. Fortunately analytical samples were obtained from most of these plants before they were badly attacked.

Dr. Harland visited the Station in March, and as the lint and seed analysis work had almost been completed made his selections for the 1931-32 season.

Experimental.

The production of commercial Sea Island strains.—Dr. Harland having decided that it is impossible to cultivate two distinct types of cotton, viz., Superfine (57 mm.) and Ordinary (51 mm.) and prevent admixture, unless two isolated seed farms are available, he has elected to eliminate the Ordinary and grow only the Superfine strain in St. Vincent; two Superfine sub-strains of V. 135 having lint lengths

of 60·5 mm. have accordingly been selected for further testing and multiplication. Sufficient seed of these strains will be available for planting the whole Island in September, 1933; meanwhile seed of other Superfine strains, having lint lengths of over 57 mm., is to be multiplied next season (1931-32) with the hope of having sufficient seed to plant the Island's crop in September, 1932.

The cross, Trinidad Red Kidney × Sea Island, has given very promising results, one sub-strain giving a 57 mm. lint length, a 60 mg. lint index and a ginning percentage of 28·8. The object of this cross is to produce superfine lint on a plant having a red leaf and weak spot. Any vicinists occurring in a commercial field of this type could then be easily detected without recourse to lint and seed analysis. Five hundred and twenty plants of this cross will be planted next season for examination and selection.

Crosses were made this season between V. 135 and H. 23 and V. 135 and a high-yielding, white-flowered mutant of V. 135 with the hope of producing a high-yielding plant having lint of superfine length and quality. The crosses will be back crossed next season to their high-yielding parents.

The production of commercial perennial strains.—Very promising results were obtained from Moco strains, but it was decided that further testing next season was necessary before seed could be distributed. Six sub-strains of a type of Marie Galante will also be tested next season at Union Island, one of the St. Vincent Grenadines.

Shedding and budding experiment.—Dr. Harland has made selections of the strains which (*a*) shed least, (*b*) shed most and (*c*) have the highest number of buds at time of appearance of first flower. The progeny of these strains will be tested next season to determine to what extent the parental characters of shedding and budding are inherited.

Time to apply fertilizer.—Results were obtained which demonstrated the fact that, under the conditions of the experiment, fertilizer applied 6 weeks after germination gave significantly higher yields than if applied 1, 2, 3, 4 or 5 weeks after germination.

Experiment to determine whether a positive correlation exists between Tuft Grade and Lint Index.—No correlation was obtained between these two characters.

Mutations.—Although crosses were made between a leaf-distorted mutant of a white-flowered mutation of V. 135 and its parent, no mature seeds were obtained on account of the ravages of pink boll worm. The mutant was, however, propagated vegetatively and further crosses will be made next season.

Tours.

Four days were spent by Mr. Evelyn in Carriacou in January to report on the cotton industry of that Island. Full reports have been sent, through the Commissioner of Agriculture, to the Governments concerned.

Ten days were spent in St. Kitts for the purpose of reporting on the purity of the commercial and seed farm cotton and at the same time to learn the method of seed selection and multiplication employed in that Island. A month was spent in Montserrat, where the interest centred in the examination of the seed fields, Station plots and commercial fields. The report on this visit has been sent to the Acting Commissioner of Agriculture.

FIJI

REPORT OF THE COTTON EXPERIMENT STATION, SIGATOKA, FOR THE SEASON 1930-31.

Summary of Results.

BY

R. R. ANSON.

The season has been a disastrous one for cotton. Towards the end of February the whole of the cotton-growing belt was visited by a hurricane and floods, causing at least 80% of the crop to be washed completely out. The Station was covered with from 6 feet to 7 feet of water which caused extremely heavy damage to crops and rendered experiments practically useless. Fortunately an adequate number of plant selections in both Sea Island and the New Guinea × Sea Island backcross were saved. Plants which withstood the flood, should show a fair resistance to wet feet and may ultimately prove to be successful, not only in the dry belt, but perhaps on the borders between the wet and dry zones where the rainfall is heavier.

Sea Island cotton (Selections from S.17) will be given out to all districts during the coming season, but it is anticipated that the acreage will be greatly reduced owing to the low prices offered for seed cotton and to abnormal floods having occurred on the river flats during two successive seasons, thus disheartening a considerable number of small Indian farmers to such an extent as to cause them to abandon their holdings.

Sea Island × New Guinea backcrosses continue to show promise; the hybrid has well maintained its productivity and despite continued selfing and unfavourable growing conditions, it has in most instances more than doubled the yield obtained from Sea Island cotton. Single plant selections will be planted out on isolated plots during the coming season. Small samples of seed have been sent to the West Indies and also to the Sudan for trial. Samples forwarded to England for testing were, in the preliminary examination, classed by Messrs. Wolstenholme and Holland as Good Grade, Creamy Colour, $1\frac{3}{4}''$ Staple, Strong, Moderately Fine and Lustrous, and nominally valued at 1·50d. below Extra Fine Sakel. Subsequent spinning tests carried out by the

Shirley Institute indicated that the Fiji hybrids were appreciably longer than the best Sakels, but considerably weaker. In the selections made for the coming season particular attention has been paid to these characters and it is hoped that the progeny will prove to be more satisfactory.

A meeting of Fijian chiefs was held at the Station in order to discuss an agricultural instructional scheme for Fijians and such a scheme has now been commenced under the supervision of the Cotton Station staff. Twenty Fijians are being settled on two centres, each of 150 acres, and it is hoped to start another centre next month with another twenty men. The crops to be planted on each centre include cotton, rice, potatoes, bananas, yams etc; and legumes. At present the natives are quite enthusiastic and, should the scheme prove successful in this district, it is intended to extend it throughout the islands.

Pests and diseases.—Jassid attack was fairly severe from February until about the middle of May when it abated and by June it had practically disappeared.

Pink bollworm was more prevalent this season than last, but the amount of damage caused by it was at no time serious.

Stainers were not particularly bad, but lint is weak and, generally speaking, much lower in quality, a result due mainly to the variation of the climatic conditions.

Improvements.—A further 7 acres were cleared from thick guava scrub, making the total area of flat land available for cultivation 86 acres, with 80 acres of hill slopes of which 5 were planted with "Merotti Bean" (*Hydnocarpus Wightiana—H. Anthelmintica*), 3 acres with "Tung oil" (*Aleurites Fordii*) and 1 acre with pineapples.

New quarters have been erected for the two Field Assistants.

Programme of Work, Season 1931-32.

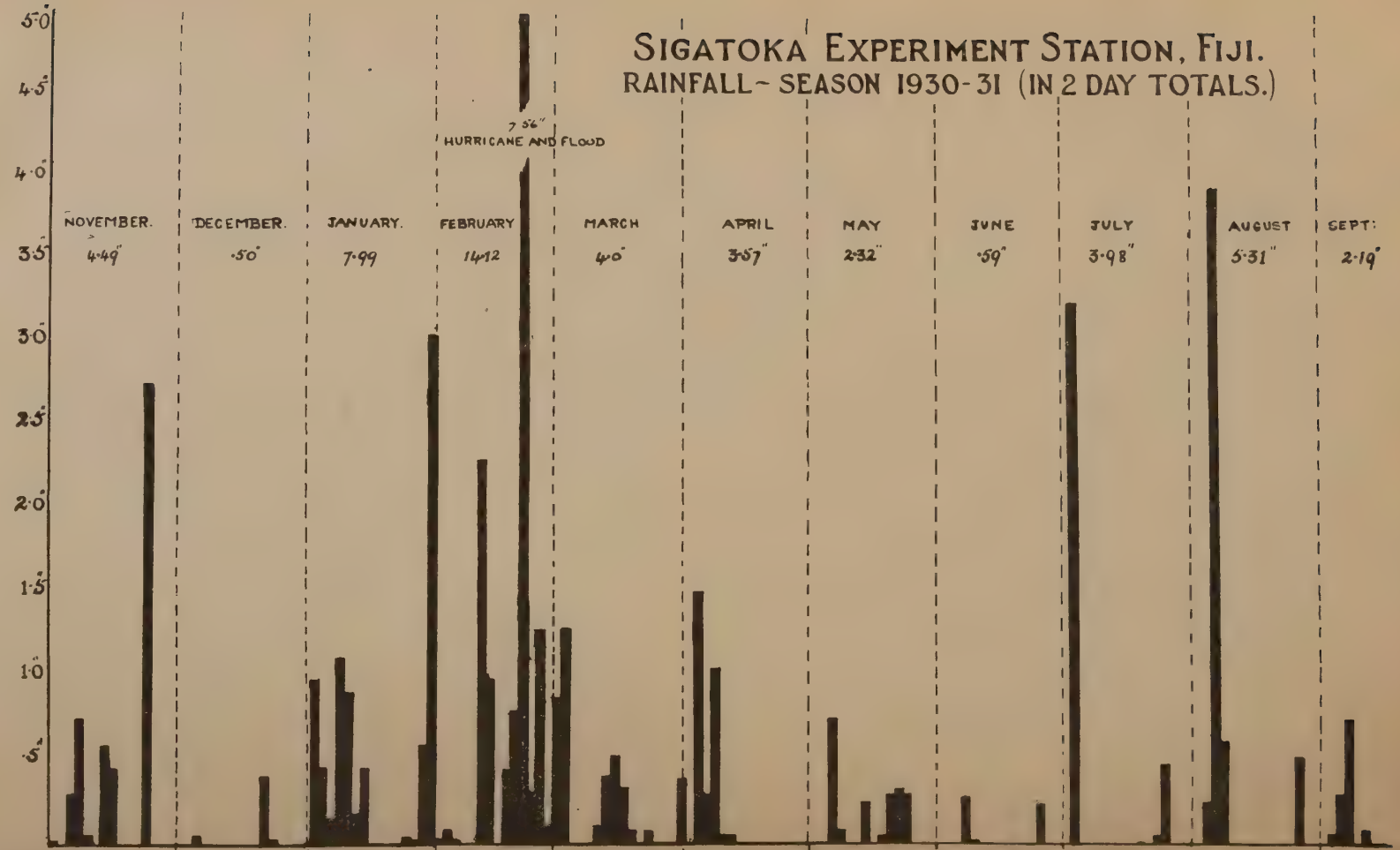
It is proposed during the coming season to try a number of crops in rotation with cotton and a series of five $\frac{1}{8}$th acre plots set out on the Latin Square system and planted with maize, cowpea, ground-nuts, mung and Mauritius bean will be followed by cotton. The variety chosen for this purpose is the New Guinea × Sea Island backcross.

The manurial tests on Sea Island carried out during the season 1930-31, will be repeated in the season 1931-32. A series of varietal tests will also be set out, and this season they will include Shambur IV Sakel, recently received from the Sudan.

Bulk and single plant selection work on Sea Island and New Guinea backcross varieties will be continued.

In order to supply seed to small farmers, much more attention will be given to minor crops which may be grown in conjunction and in rotation with cotton.

Four acres of pure line Californian rice known as " Sona-calif " and three acres of " Motka " variety are being planted for seed, seventeen varieties of tobacco are being tested and a fair area is being planted with food crops in order to supply food for Fijians attached to the Station for training purposes.


SIGATOKA EXPERIMENT STATION, FIJI.
RAINFALL~ SEASON 1930-31 (IN 2 DAY TOTALS.)
7·56"
HURRICANE AND FLOOD
5·0
4·5
4·0
3·5
3·0
2·5
2·0
1·5
1·0
·5
NOVEMBER. 4·49"
DECEMBER. ·50"
JANUARY. 7·99
FEBRUARY 14·12
MARCH 4·0"
APRIL 3·57"
MAY 2·32"
JUNE ·59"
JULY 3·98"
AUGUST 5·31"
SEPT: 2·19"

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